ПРЕДЛОЖЕНИЕ

за изпълнение на обществената поръчка

ДО: „ЧЕЗ РАЗПРЕДЕЛЕНИЕ БЪЛГАРИЯ" АД,

ОТ: АББ България ЕООД

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Представлявано от Екехарт Нойрайтер и Стефан Минчев – Управители
Лице за контакти: Стефан Минчев, тел +35928075521, факс: +35928075599, e-mail: stefan.minchev@bg.abb.com

УВАЖАЕМИ ГОСПОЖИ И ГОСПОДА,
Предоставяме на Вашето внимание предложението ни за изпълнение на обществена поръчка с предмет **„Доставка на електрически апарати 110kV"**, реф. № PPD 17-064.
Обособена позиция 2 – Доставка на токови измервателни трансформатори 110kV за монтаж на открито – 21бр.

1. В случай, че бъдем избрани за изпълнител, ще изпълним предмета на поръчката в пълно съответствие с изискванията на Възложителя, като се задължаваме да спазваме изискванията на нормативната уредба на Република България.

2. Представям техническите спецификации от раздел II на документацията с попълнени всички изисквани стойности за всички позиции от стоката по предмета на поръчката.

3. Декларирам, че предлаганото от нас оборудване отговаря на минималните технически изисквания на Възложителя, които не съдържат графа „Гарантирано предложение" в таблиците на техническите спецификации на стоката, приложение към настоящото предложение за изпълнение на поръчката.

4. Представям всички изисквани данни и документи, посочени в Приложение 2 от настоящото техническо предложение. Запознат съм с изискването, че представените документи трябва да бъдат на български език или с превод на български език, придружени с оригиналните документи, с изключение на каталозите и протоколи от изпитания */в случай, че се изискват/* за материалите, които могат да се представят и само на английски език.

5. Запознат съм, че представените от нас технически документи са доказателство за декларираните от мен технически данни и параметри в техническите спецификации на стоката.

6. Потвърждавам, че представяните от нас стоки, описани в Техническото ни предложение, ще отговарят на посочените от възложителя стандарти или на еквивалентни. В случай, че даден материал отговаря на стандарт, еквивалентен на посочения се задължаваме да го отразим в отделен документ и да представим доказателства за еквивалентността на двата стандарта.

7 Предлагам гаранционен срок за предлаганите стоки – 36 (тридесет и шест) месеца, от датата на приемо – предавателен протокол за получаване на стоката от Възложителя.
8. Срок за доставка на предлаганите стоки – 90 (деветдесет) дни от датата на поръчка от Възложителя до Изпълнителя

Приложения:

1. *Приложение 1 - Технически изисквания и спецификации за изпълнение на поръчката – раздел II от документацията за участие – попълнени на съответните места;*
2. *Приложение 2 - Изисквани документи от приложение - Технически изисквания и спецификации;*

Дата: 14.07.2017 г.
София

С уважение:

Екехарт Нойрайтер
Управител
АББ България ЕООД

Стефан Минчев
Управител
АББ България ЕООД

ИЗИСКВАНИЯ КЪМ ДОКУМЕНТАЦИЯТА И ИЗПИТВАНИЯТА ПО ОБОСОБЕНА ПОЗИЦИЯ № 2 „ДОСТАВКА НА ТОКОВИ ИЗМЕРВАТЕЛНИ ТРАНСФОРМАТОРИ 110 KV, ЗА МОНТАЖ НА ОТКРИТО“

№	Документи при участие	Приложение № (или текст)
1.	Точно обозначение на типа на токовите измервателни трансформатори, производителя и страната на произход и последно издание на каталога на производителя	**PA 123a** ABB Sp. zo.o., Полша Приложение 1 - PA_123a_karta_en
2.	Удостоверение за одобряване на типа на токовите измервателни трансформатори, издадено по реда и при условията на Закона за измерванията	Приложение 2 - Удостоверение за одобрен тип - PA123a PA145a
3.	Техническо описание на токовите измервателни трансформатори, гарантирани параметри и характеристики, тегло и др.	Приложение 3.1 - Технически параметри на ТТ PA123a Приложение 3.2 - Чертеж на ТТ PA123a Приложение 3.3 - Волтамперна характеристика на ядрата ТТ PA123a Приложение 3.4 - Чертеж на табелата на ТТ PA123a Приложение 3.5 - Ел. схема на ТТ PA123a Приложение 3.6 - Чертеж на клемната кутия на ТТ PA123a Приложение 3.7 - instrukcja PA 123a-145a EN_lo-res Приложение 3.8 - Сертификат за съответствие PAa_123_ABB Приложение 3.9 - Nytro_10XN_PO_EN_SDS Приложение 3.10 - Nytro_Libra_PO_EN_SDS
4.	Протоколи от типови изпитвания на токовите измервателни трансформатори на английски или български език, проведени от независима изпитателна лаборатория с приложени резултати от изпитванията	Приложение 4 - Протоколи от типови изпитания на ТТ PA123a
5.	Сертификат/акредитация на независимата изпитателна лаборатория, провела типовите изпитвания – заверено копие	Приложение 5.1 - ISO 17025-_ABB Przasnysz Приложение 5.2 - Сертификат за акредитация 117 323 324
6.	Информация за провежданите от производителя контролни (рутинни) изпитвания	Приложение 6 - Routine Test Plan for Current Transformer

ТАБЛИЦА 1

Стандарт на материала за токови измервателни трансформатори 110 kV за монтаж на открито

Технически параметри на токови измервателни трансформатори 110 kV, за монтаж на открито, които се попълват от Участника в графа „Гарантирано предложение“:

Наименование на материала		Токов измервателен трансформатор 110 kV, 200/400/800/5/5/5/5 A за монтиране на открито	
Съкратено наименование на материала		ТИТ 110 kV, 200/400/800/5/5/5/5 A, OM	
№	**Параметър**	**Изискване**	**Гарантирано предложение**
1.	Тип/референтен номер съгласно каталога на производителя	Да се посочи	**PA 123a**
2.	Производител	Да се посочи	ABB Sp. zo.o., Полша

Характеристика на материала:

Токови индуктивни еднополюсни подпорни измервателни трансформатори 110 kV, с изолаторно тяло от порцелан/полимер, и вътрешна изолационна среда - масло (без PCB), за монтиране на открито, с първично превключване на коефициента на трансформация, с обявени коефициенти на трансформация 200/400/800//5/5/5/5 A като вторичните намотки са както следва:

- две намотки за целите на измерването;
- две намотки за целите на защитата.

Токовите измервателни трансформатори са от одобрен тип, преминали са през първоначална метрологична проверка и са маркирани със съответния знак по реда и при условията на „Наредба за средствата за измерване, които подлежат на метрологичен контрол“ по чл. 28, от Закона за измерванията.

Използване:

Токовите измервателни трансформатори са предназначени за захранване на токовите вериги на електромерите за търговско и контролно измерване на електрическа енергия, на релейните защити и на контролно-измервателните апарати и сигнализацията в електрическите разпределителни уредби.

Съответствие на предложеното изпълнение със стандартизационните документи:
Токовите измервателни трансформатори трябва да отговарят на:

- БДС EN 61869-2:2012 „Измервателни трансформатори. Част 2: Допълнителни изисквания за токови трансформатори (IEC 61869-2:2012)" и на неговите валидни изменения и допълнения или еквивалентно/и.

Параметри на електрическата разпределителна мрежа

№	Параметър	Стойност
1.	Обявено напрежение	110 000 V
2.	Максимално работно напрежение	123 000 V
3.	Най-високо напрежение между фаза-земя при нормални условия	71 kV
4.	Обявена честота	50 Hz
5.	Заземяване на звездния център	Директно заземен

Характеристики на работната среда и място на монтиране

№	Характеристика /място на монтиране	Стойност/описание
1.	Максимална околна температура	+ 40°C
2.	Минимална околна температура	Минус 25°C
3.	Относителна влажност	До 95 %
4.	Замърсяване с прах, пушек, агресивни газове и пари	Умерено
5.	Надморска височина	До 1 000 m
6.	Място на монтиране	В открити разпределителни уредби 110 kV

Конструктивни характеристики и др. данни за токови измервателни трансформатори 110 kV за монтаж на открито, за които Участникът декларира в техническото си предложение – Раздел V от настоящата документация, че предложеното от него оборудване отговаря на посочените минимални технически изисквания на Възложителя, посочени в таблицата по-долу:

№	Характеристика	Минимални технически изисквания
1.	Конструкция	а) Токовите измервателни трансформатори трябва да бъдат от подпорен тип с изолаторно тяло от порцелан/полимер и вътрешна изолираща среда от масло (без PCB)
		б) Токовите измервателни трансформатори трябва да бъдат съоръжени с подходящи клеми с винтови съединения, за свързване на първичната намотка и клемен блок за свързване на вторичните вериги.
2.	Вторични намотки - брой и предназначение	а) две намотки за целите на измерването;
		б) две намотки за целите на защитата
3.	Монтиране	Токовите измервателни трансформатори трябва да позволяват монтиране във вертикално положение.
4.	Клеми за свързване на първичната намотка	Клемите трябва да бъдат изработени от подходящ метал или метална сплав, недопускащи електрохимична корозия.
5.	Клемен блок за свързване на вторичните вериги	а) Клемният блок трябва да бъде поместен в защитна клемна кутия с IP44, с възможност за пломбиране
		б) Клемите на клемният блок трябва да бъдат изработени от месинг или друга подходяща некорозираща сплав.
6.	Резбови и скрепителни съединения	Всички резбови и скрепителни съединения трябва да бъдат изработени от подходящи некорозиращи метали или метални сплави.
7.	Маркиране на обявените стойности	Токовите измервателни трансформатори трябва да бъдат маркирани с информация за обявените стойности върху табелка съгласно изискванията на т. 6.13 от БДС EN 61869-2 или еквивалентно/и.

№	Характеристика	Минимални технически изисквания
8.	Маркиране на изводите	Изводите на токовите измервателни трансформатори трябва да бъдат маркирани трайно и четливо съгласно изискванията на т. 6.13 от БДС EN 61869-2 или еквивалентно/и.
9.	Първоначална проверка и знаци за удостоверяване (съгласно разпоредбите на Закона за измерванията)	а) При доставка, токовите измервателни трансформатори трябва да бъдат с извършена, валидна към момента първоначална метрологична проверка.
		б) Първоначалната метрологична проверка трябва да бъде удостоверена със знак за първоначална проверка и копието на протокола от проведените изпитвания.
10.	Транспортна опаковка	Токовите измервателни трансформатори трябва да бъдат защитени посредством подходяща опаковка, предпазваща ги от повреди и въздействия на околната среда, подредени и закрепени на транспортни палети.
11.	Експлоатационна дълготрайност	≥ 25 години

Общи технически параметри, характеристики и др. данни за токови измервателни трансформатори 110 kV за монтаж на открито, за които Участникът декларира в техническото си предложение – Раздел V от настоящата документация, че предложеното от него оборудване отговаря на посочените минимални технически изисквания на Възложителя, посочени в таблицата по-долу:

№	Параметър	Минимални технически изисквания
1	Обявени коефициенти на трансформация	200/400/800//5/5/5/5 A
2	Превключване на коефициента на трансформация	Първично
3	Изолаторно тяло	Порцелан или полимер
4	Класове на точност:	
-	измервателната намотка - търговско мерене	≤ 0,2 S
-	измервателна намотка - контролно мерене	≤ 0,2 S
-	2 бр. намотки за защитите: 1 бр. за резервна МТЗ; и 1 бр. за НДЗ	≤ 10 P
5	Номинална вторична мощност:	
-	измервателни намотки	≥ 15 VA
-	защитни намотки	≥ 30 VA
6	Обявен първичен ток, I_{pr}	200/400/800 A
7	Обявени вторични токове	x//5/5/5/5 A
8	Обявен продължителен термичен ток, I_{cth}	≥ 1,2 x I_{pr}
9	Обявен първичен ток на термична устойчивост, I_{th}	≥ 31,5 kA/1s
1	Обявен електродинамичен ток, I_{dyn}	≥ 78.8 kA
1	Номинален коефициент на безопасност - FS	≥ 5
1	Обявено издържано напрежение с промишлена честота за изолацията на първичната намотка	230 kV (ефективна стойност)
1	Обявено издържано напрежение с мълниев импулс за изолацията на първичната намотка	550 kV (върхова стойност)
1	Обявено издържано напрежение с промишлена честота на изолацията за вторичните намотки	3 kV (ефективна стойност)
1	Най-високо напрежение за съоръженията, U_m	123 kV (ефективна стойност)
1	Допустими нива на частичния разряд при 1,2 $U_m/\sqrt{3}$	≤ 20 pC
1	Път на пропълзяване по повърхността на изолатора	≥ 31 mm/kV
1	Сеизмична устойчивост	≥ 0.3 g

Дата: 14.07.2017 г.
София

С уважение:

Екехарт Нойрайтер
Управител
АББ България ЕООД

Стефан Минчев
Управител
АББ България ЕООД

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Certificate

Standard **ISO 9001:2015**

Certificate Registr. No. 01 100 1541808

Certificate Holder: **ABB Sp. z o.o.**
ul. Żegańska 1
04-713 Warszawa

including the locations according to annex

Scope: Research and development as well as design, programming, manufacturing, sale, process and final testing, services and turnkey execution:
· distribution and power transformers, insulation kits as well as painting and welding works; dry transformers including also components for dry transformers, components for traction transformers
· low, medium and high voltage electrical apparatus and power systems;
· automation products including control and measurement equipment, motors, interlocks
· and protection, informative as well as automation systems for power facilities and industry;
· gas compressor and metering stations, gas compressor units and equipment, underground gas storages, gas pipelines and similar services for gas industry petroleum rafineries and petrochemical industry;
· robots and industrial robotics stations;
· supercharging of diesel and gas engines;
· main host;
· production of low voltage motors;
· production of power electronics and medium voltage drives.
· Computer software production and implementation.
Technical training in scope of automatics, robotics and electrical power equipment and systems
Programs science and research in the fields of power and automation

Proof has been furnished by means of an audit that the requirements of ISO 9001:2015 are met.

Validity: The certificate is valid from 2016-11-29 until 2019-11-28.
First certification 2013

2016-11-24

Grzegorz Grabka

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Annex to certificate

Standard **ISO 9001:2015**

Certificate Registr. No. 01 100 1541808

No.	Location	Scope
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0198 113 00113 /02	**Oddział w Łodzi** ABB Sp. z o.o. ul. Aleksandrowska 67/93 91-205 Łódź	
0198 113 00113 /03	**Oddział w Aleksandrowie Łódzkim** ABB Sp. z o.o. ul. Placydowska 27 95-070 Aleksandrów Łódzki	
0198 113 00113 /04	**Oddział w Krakowie** ABB Sp. z o.o. ul. Wadowicka 12 30-415 Kraków	
0198 113 00113 /05	**Oddział w Krakowie** ABB Sp. z o.o. ul. Starowiślna 13A 31-038 Kraków	
0198 113 00113 /06	**Oddział w Elblągu** ABB Sp. z o.o. ul. Królewiecka 11 82-300 Elbląg	

Annex to certificate

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Certificate Registr. No. 01 100 1541808

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0198 113 00113 /08	**Oddział we Wrocławiu** ABB Sp. z o.o. ul. Graniczna 8B 54-610 Wrocław
0198 113 00113 /09	**Oddział we Wrocławiu** ABB Sp. z o.o. ul. Bacciarellego 54 51-649 Wrocław

2016-11-24

Grzegorz Grabka

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СЕРТИФИКАТ

/превод от английски език/

Стандарт **ISO 9001:2015**

Рег. Ном.: 01 100 1541808

Носител на сертификата: АББ Сп. з о.о.
ул. Зеганска 1
04-713 Варшава
включително локациите съгласно приложението

Обхват: Проучване и разработване, както и проектиране, програмиране, производство, продажба, процедиране и финално изпитване, сервизни услуги и цялостно изпълнение „под ключ" на следното:

- Разпределителни и силови трансформатори, изолационни комплекти, както и работи по боядисване и заваряване; сухи трансформатори включително също компоненти за сухи трансформатори, компоненти за тягови трансформатори
- Електрически апарати за ниско, средно и високо напрежение и електрически системи
- Продукти за автоматизация включително апаратура за управление и измерване, двигатели и блокировки
- И защита, информативна както и система за автоматизация за енергийни обекти и индустрията
- Газ-компресорни и измервателни станции, газ-компресорни блокове и оборудване, подземни хранилища за газ, газопроводи и подобни услуги за газовата индустрия петролни рафинерии и нефтената химическа промишленост
- Главно хранилище
- Роботи и индустриални роботизирани станции
- Суперзареждане на дизелови и газ двигатели
- Производство на двигатели ниско напрежение
- Производство на силова електроника и задвижвания за двигатели средно напрежение
- Производство на компютърен програмен софтуер и внедряване.

Техническо обучение в обхват на автоматика, роботика и електрическо силово оборудване и системи.

Доказателства са представени , въз основа на проведения одит, че изискванията съгласно ISO 9001:2015 са изпълнени.

Валидност: Този сертификат е валиден от 29.11.2016г. до 28.11.2019 г.
Първа сертификация 2013 г.

24.11.2016 г.

Подпис /не се чете/
ТЮВ Реиланд Серт
Am Grauen Stein, 51105 Кьолн

Приложение към СЕРТИФИКАТ

Стандарт **ISO 9001:2015**

Рег. Ном.: 01 100 1541808

№	Локация:	Обхват
0198 113 00113/01	АББ Сп. з о.о. ул. Зеганска 1 ПЛ 04-713 Варшава	както е в сертификата
0198 113 00113/02	Клон в Луч, АББ Сп. з о.о. ул. Александровска67/93, ПЛ-91-205 Луч	
0198 113 00113/03	Клон в Александровие Лучким, АББ Сп. з о.о. ул. Плачидовска 27 ПЛ-95-070 Александров Лучким	
0198 113 00113/04	Клон в Краков, АББ Сп. з о.о. ул. Вадовичка 12 ПЛ-30-415 Краков	
0198 113 00113/05	Клон в Краков, АББ Сп. з о.о. ул. Старовислна 13А ПЛ-31-038 Краков	
0198 113 00113/06	Клон в Елблагу, АББ Сп. з о.о. ул. Кролевиецка 11 ПЛ-82-300 Елблаг	

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Приложение към СЕРТИФИКАТ

Стандарт **ISO 9001:2015**

Рег. Ном.: 01 100 1541808

0198 113 00113/07	Клон в Пшаснич, АББ Сп. з о.о. ул. Лесно 59 ПЛ-06-300 Пшаснич
0198 113 00113/08	Клон в Вроцлав, АББ Сп. з о.о. ул. Гранична 8В ПЛ-54-610 Вроцлав
0198 113 00113/09	Клон в Вроцлав, АББ Сп. з о.о. ул. Бачиарелего 54 ПЛ-51-649 Вроцлав

24.11.2016 г.

Подпис /не се чете/
ТЮВ Реиланд Полска Сп. з о.о.
ул. 17 Стижна 56 02-146 Варшава

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Certificate

Standard **ISO 14001:2015**

Certificate Registr. No. 01 104 1541809

Certificate Holder: **ABB Sp. z o.o.**
ul. Żegańska 1
04-713 Warszawa

including the locations according to annex

Scope: Research and development as well as design, programming, manufacturing, sale, process and final testing, services and turnkey execution:
· distribution and power transformers, insulation kits as well as painting and welding works; dry transformers including also components for dry transformers, components for traction transformers
· low, medium and high voltage electrical apparatus and power systems;
· automation products including control and measurement equipment, motors, interlocks
· and protection, informative as well as automation systems for power facilities and industry;
· gas compressor and metering stations, gas compressor units and equipment, underground gas storages, gas pipelines and similar services for gas industry petroleum rafineries and petrochemical industry;
· robots and industrial robotics stations;
· supercharging of diesel and gas engines;
· main host;
· production of low voltage motors;
· production of power electronics and medium voltage drives.
· Computer software production and implementation.
Technical training in scope of automatics, robotics and electrical power equipment and systems
Programs science and research in the fields of power and automation

Proof has been furnished by means of an audit that the requirements of ISO 14001:2015 are met.

Validity: The certificate is valid from 2016-11-29 until 2019-11-28.
First certification 2013

2016-11-24

Grzegorz Grabka

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

www.tuv.com

IAF

DAkkS
Deutsche Akkreditierungsstelle
D-ZM-16031-01-00

TÜVRheinland®
Precisely Right.

Annex to certificate

Standard **ISO 14001:2015**

Certificate Registr. No. 01 100 1541809

No.	Location	Scope
0198 113 00113 /01	**ABB Sp. z o.o.** ul. Żegańska 1 04-713 Warszawa	As for certificate
0198 113 00113 /02	**Oddział w Łodzi** ABB Sp. z o.o. ul. Aleksandrowska 67/93 91-205 Łódź	
0198 113 00113 /03	**Oddział w Aleksandrowie Łódzkim** ABB Sp. z o.o. ul. Placydowska 27 95-070 Aleksandrów Łódzki	
0198 113 00113 /04	**Oddział w Krakowie** ABB Sp. z o.o. ul. Wadowicka 12 30-415 Kraków	
0198 113 00113 /05	**Oddział w Krakowie** ABB Sp. z o.o. ul. Starowiślna 13A 31-038 Kraków	
0198 113 00113 /06	**Oddział w Elblągu** ABB Sp. z o.o. ul. Królewiecka 11 82-300 Elbląg	

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Annex to certificate

Standard **ISO 14001:2015**

Certificate Registr. No. 01 100 1541809

0198 113 00113 /07	**Oddział w Przasnyszu** ABB Sp. z o.o. ul. Leszno 59 06-300 Przasnysz
0198 113 00113 /08	**Oddział we Wrocławiu** ABB Sp. z o.o. ul. Graniczna 8B 54-610 Wrocław
0198 113 00113 /09	**Oddział we Wrocławiu** ABB Sp. z o.o. ul. Bacciarellego 54 51-649 Wrocław

2016-11-24

Grzegorz Grabka

TÜV Rheinland Polska Sp. z o.o.
ul. 17 Stycznia 56 02-146 Warszawa

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СЕРТИФИКАТ

/превод от английски език/

Стандарт **ISO 14001:2015**

Рег. Ном.: 01 104 1541809

Носител на сертификата: АББ Сп. з о.о.
ул. Зеганска 1
04-713 Варшава
включително локациите съгласно приложението

Обхват: Проучване и разработване, както и проектиране, програмиране, производство, продажба, процедиране и финално изпитване, сервизни услуги и цялостно изпълнение „под ключ" на следното:

- Разпределителни и силови трансформатори, изолационни комплекти, както и работи по боядисване и заваряване; сухи трансформатори включително също компоненти за сухи трансформатори, компоненти за тягови трансформатори
- Електрически апарати за ниско, средно и високо напрежение и електрически системи
- Продукти за автоматизация включително апаратура за управление и измерване, двигатели и блокировки
- И защита, информативна както и система за автоматизация за енергийни обекти и индустрията
- Газ-компресорни и измервателни станции, газ-компресорни блокове и оборудване, подземни хранилища за газ, газопроводи и подобни услуги за газовата индустрия петролни рафинерии и нефтената химическа промишленост
- Главно хранилище
- Роботи и индустриални роботизирани станции
- Суперзареждане на дизелови и газ двигатели
- Производство на двигатели ниско напрежение
- Производство на силова електроника и задвижвания за двигатели средно напрежение
- Производство на компютърен програмен софтуер и внедряване.

Техническо обучение в обхват на автоматика, роботика и електрическо силово оборудване и системи.

Доказателства са представени , въз основа на проведения одит, че изискванията съгласно ISO14001:2015 са изпълнени.

Валидност: Този сертификат е валиден от 29.11.2016г. до 28.11.2019 г.
Първа сертификация 2013 г.

24.11.2016 г.

Подпис /не се чете/
ТЮВ Реиланд Серт
Am Grauen Stein, 51105 Кьолн

Приложение към СЕРТИФИКАТ

Стандарт **ISO 14001:2015**

Рег. Ном.: 01 104 1541809

№	Локация:	Обхват
0198 113 00113/01	АББ Сп. з о.о. ул. Зеганска 1 ПЛ 04-713 Варшава	както е в сертификата
0198 113 00113/02	Клон в Луч, АББ Сп. з о.о. ул. Александровска67/93, ПЛ-91-205 Луч	
0198 113 00113/03	Клон в Александровие Лучким, АББ Сп. з о.о. ул. Плачидовска 27 ПЛ-95-070 Александров Лучким	
0198 113 00113/04	Клон в Краков, АББ Сп. з о.о. ул. Вадовичка 12 ПЛ-30-415 Краков	
0198 113 00113/05	Клон в Краков, АББ Сп. з о.о. ул. Старовислна 13А ПЛ-31-038 Краков	
0198 113 00113/06	Клон в Елблагу, АББ Сп. з о.о. ул. Кролевиецка 11 ПЛ-82-300 Елблаг	

Приложение към СЕРТИФИКАТ

Стандарт **ISO 14001:2015**

Рег. Ном.: 01 104 1541809

0198 113 00113/07	Клон в Пшаснич, АББ Сп. з о.о. ул. Лесно 59 ПЛ-06-300 Пшаснич
0198 113 00113/08	Клон в Вроцлав, АББ Сп. з о.о. ул. Гранична 8В ПЛ-54-610 Вроцлав
0198 113 00113/09	Клон в Вроцлав, АББ Сп. з о.о. ул. Бачиарелего 54 ПЛ-51-649 Вроцлав

24.11.2016 г.

Подпис /не се чете/
ТЮВ Реиланд Полска Сп. з о.о.
ул. 17 Стижна 56 02-146 Варшава

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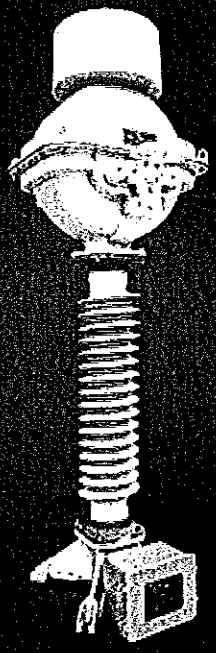
„Доставка на електрически апарати 110kV“, реф. № PPD 17-064.

Обособена позиция 2 – Доставка на токови измервателни трансформатори 110kV за монтаж на открито – 21бр.

ПРИЛОЖЕНИЕ 1



High Voltage Products

Current transformers PA 123a and PA 145a

Power and productivity
for a better world™

ABB

Product description

The PVA 123a and PVA 145a current transformers are used for feeding measurement and protection systems in electric power grids with the highest system voltage of 123 kV or 145 kV, respectively, and frequency of 50 Hz. They are designed to operate in grids with effectively earthed or insulated neutral points as well as in compensated earthed systems. The transformers are suitable to operate in outdoor conditions with ambient temperature from 233 K (-40°C) to 313 K (+40°C) and at relative humidity of up to 100% at 303 K (+30°C), at an altitude not exceeding 1000 m above sea level. Two designs are available: with composite or porcelain insulator.

Current transformers type PA 123a and PA 145a feature a top core design; active parts are placed in a tight enclosure filled with PCB-free transformer oil.
The covered transformer's stainless steel compensation bellows in casing is fixed to the head. The compensation bellows compensates for thermal changes in oil volume.

Top core construction
The use of the top core design in the current transformer makes it possible to achieve high values of thermal and dynamic short-circuit currents as well as a broad range of rated primary currents and burdens of secondary windings.

Primary and secondary windings and accuracy classes
The primary and secondary windings are made of electrical copper and aluminum. For clients requiring high transformation accuracy with low values of selected rated primary currents, we are able to deliver a solution comprising the use of special classes 0.2S and 0.5S. We guarantee very high transformation accuracy in the special classes, from 1% to 120%, 150% and even to 200% of the value of selected primary current for both secondary currents of 1 A and 5 A.
Secondary windings for protection purposes are offered in all accuracy classes, namely: 5P, 10P, 5PR, 10PR, TPX, TPY, TPZ, PX, PXR.
Our laboratory for measurements of accuracy classes of instrument transformers is one of the most advanced and well-equipped research facilities in the country. We are accredited by the Polish Central Office of Measures.

Current range switching
The transformer can be switched on the primary side as well as on the secondary side. A metal jumper is used for current range switching on the primary side. It shall be placed in appropriate location in accordance with the terminal board. This solution does not require performance of additional operations related to change of location of line connections.

Main insulation
The main insulation is made of insulation paper impregnated with transformer oil. We utilize high quality oil conforming to IEC 60296 Standard requirements. This oil does not contain PCBs or any other highly toxic substances and has low environmental impact.

Hollow insulator
The standard insulator is made of brown porcelain with creepage distance required for the 3rd pollution zone. A grey composite insulator with creepage distance required for the 4th pollution zone is available upon request. All materials used in the production of our insulators conform to relevant IEC Standards.

Enclosure
All external parts are robust and made of corrosion resistant materials. All enclosure joints are leak proof due to O-ring sealing system. Each completely assembled unit is subject to stringent leakage checks during routine testing. The expansion bellows is equipped with a large oil level indicator that enables observations of changes in oil volume even from a large distance.

Primary terminals
The standard primary terminals are flat, made of aluminum, and their width is 100 mm or 200 mm. Upon request we can offer pin type primary terminals, made of copper or aluminum, with a diameter of 30 mm or 40 mm.

Terminal box
The terminal box is made of aluminum and fixed to the transformer's bottom tank. Tightness – according to IP55. Secondary terminals are available for connection of conductors with cross-section of up to 10 mm². Sealing of current measurement terminals is also possible upon request. The standard terminal box is equipped with two M40 cable glands (for cables from Ø 19 mm to Ø 28 mm). We offer terminal boxes with different number of cable glands upon request. IT's with two secondary boxes are available upon request (possibility of splitting into measuring and protective part).

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Technical specifications

General information

Parameter	Value	
Type	PA 123a	PA 145a
Compliance with standards	IEC 61869-2; PN-EN 61869-2	
Highest system voltage	123 kV	145 kV
Power-frequency withstand test voltage	50 Hz 230 kV	50 Hz 275 kV
Rated lighting-impulse withstand voltage	1,2/50 µs 550 kV	1,2/50 µs 650 kV
Minimum creepage distance	16; 20; 25; 31 mm/kV	
Rated frequency	50 Hz	
Total weight [max.]	420; 360* kg	

*Composite insulator.

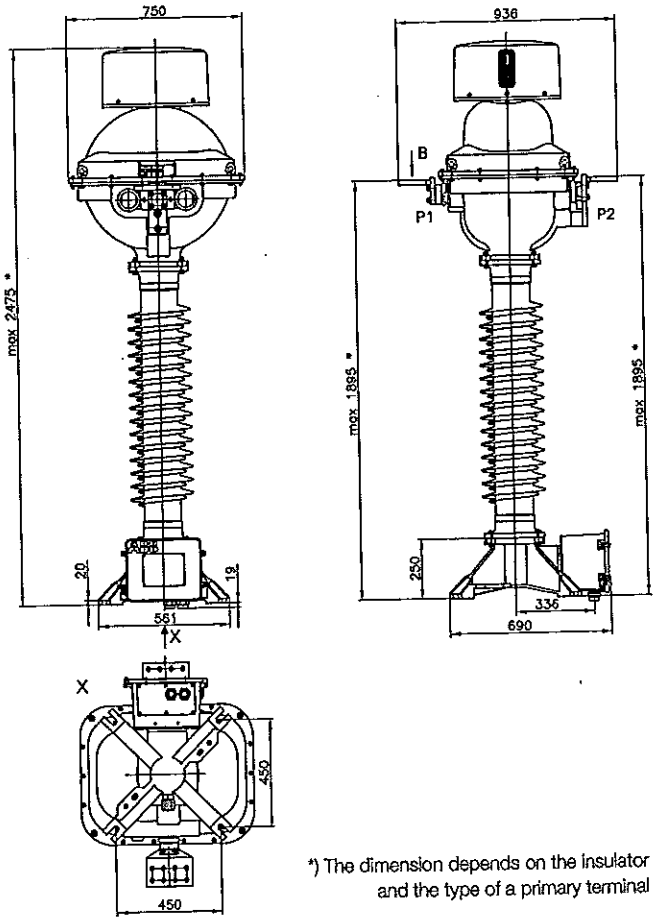
Current module

Rated current [A]	Short-circuit thermal current 1 s [kA]	Dynamic short-circuit current [kA]
50–3000	up to 63	up to 157

Switched design 1:2 or 1:2:4 on request.

Parameter	Value
Rated secondary current	1 A; 5 A
Extended current range	120%; 150%; 200%
Number of cores	1–6
Measuring cores parameters:	
– total rated output	1–200 VA
– accuracy class	0,1; 0,2; 0,2S; 0,5; 0,5S; 1; 3; 5
Protection cores parameters:	
– total rated output	1–200 VA
– accuracy class	5P, 10P, 5PR, 10PR, TPX, TPY, TPZ, PX, PXR

Dimensional drawing



*) The dimension depends on the insulator and the type of a primary terminal

More information

ABB Contact Center
ph.: +48 22 22 37 777
e-mail: kontakt@pl.abb.com

ABB Sp. z o.o.
Branch Office in Przasnysz
ul. Leszno 59
06-300 Przasnysz
ph.: +48 22 22 38 931, +48 22 22 39 255
fax: +48 22 22 38 958

www.abb.pl

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„Доставка на електрически апарати 110kV“, реф. № PPD 17-064.

Обособена позиция 2 – Доставка на токови измервателни трансформатори 110kV за монтаж на открито – 21бр.

ПРИЛОЖЕНИЕ 2

РЕПУБЛИКА БЪЛГАРИЯ
Български институт по метрология

REPUBLIC OF BULGARIA
Bulgarian Institute of Metrology

УДОСТОВЕРЕНИЕ ЗА ОДОБРЕН ТИП СРЕДСТВО ЗА ИЗМЕРВАНЕ

Measuring Instrument Type-approval Certificate

№ 16.05.5104

Издадено на производител: / *Issued to manufacturer:* ABB Sp. zo. o., Poland
06-300 Przasnysz, ul. Leszno 59

На основание на: / *In Accordance with:* чл. 32, ал. 1 от Закона за измерванията (ДВ, бр. 46 от 2002 г., изм. бр. 88 от 05 г., изм. и доп. бр. 95 от 2005 г.)

Относно: / *In Respect of:* измервателни токови трансформатори тип PA 123a, PA 145a

Знак за одобрен тип: / *Type Approval Mark:* BG 16 5104

Технически и метрологични характеристики: / *Technical and metrological characteristics:* приложение, неразделна част от настоящото удостоверение за одобрен тип средство за измерване

Срок на валидност: / *Valid until:* 12.05.2026 г.

Вписва се в регистъра на одобрените за използване типове средства за измерване под №: / *Reference №:* 5104

Дата на издаване на удостоверението за одобрен тип: / *Date:* 12.05.2016 г.

И. Д. ПРЕДСЕДАТЕЛ:
Пауъ Илчев

БЪЛГАРСКИ ИНСТИТУТ ПО МЕТРОЛОГИЯ 2 КИЛОФИЯ РЕПУБЛИКА БЪЛГАРИЯ

Приложение към удостоверение за одобрен тип № 16.05.5104

Издадено на производител: ABB Sp. zo. o., Poland, 06-300 Przasnysz, ul. Leszno 59

Относно: измервателни токови трансформатори тип PA 123a, PA 145a

1. Описание на типа:

Измервателните токови трансформатори тип PA 123a и PA 145a се използват за измерване и защита на електрически мрежи с максимално допустимо работно напрежение до 123 kV и 145 kV и честота 50 Hz. Те са проектирани да работят в системи с ефективно заземен или изолиран звезден център, както и в компенсирани системи. Предназначени са за външен монтаж.

Активната част на токовите трансформатори се състои от първична намотка, вторични намотки и ядро, разположени в херметичен корпус запълнен с трансформаторно масло, не съдържащо полихлорирани бифинили PCB. Ядрата са разположени в горната част на токовия трансформатор.

Първичната и вторичната намотки са направени от висококачествена електротехническа мед, позволяваща висок клас на точност започващ от 0,1 при ниски стойности на номиналния първичен ток. При измервателните токови трансформатори тип PA 123a и PA 145a има възможност за превключване на първичната намотка.

Изолаторът може да бъде направен от порцелан с път на утечка 25 mm/kV или 31 mm/kV. Възможно е той да бъде изработен и от полимерен композитен материал с път на утечка 31 mm/kV.

Токовите трансформатори тип PA 123a и PA 145a са подходящи за работа в условия на открито с температура на околната среда от –40 °C до +40 °C при относителна влажност на въздуха до 100% при 30 °C и надморска височина до 1000 m. Трансформаторите са изработени за общо механично натоварване от скоростта на вятъра до 34 m/s, поледица с дебелина до 20 mm и до опъване на проводника не повече от 500 N.

Вторичните клеми са обозначени със стандартни маркировки на изводите. Всички външни метални части са изработени от корозоустойчиви материали.

2. Технически и метрологични характеристики:

Характеристика	Трансформатори тип PA 123a	Трансформатори тип PA 145a
Максимално работно напрежение, kV	123	145
Честота, Hz	50	
Номинален първичен ток, A	от 50 до 3000	
Клас на точност: - измервателна намотка: - защитна намотка:	0,1; 0,2S; 0,2; 0,5S; 0,5; 1; 3; 5 5P; 10P; 5PR; 10PR; PX; PXR; TPX; TPY; TPZ;	
Коефициент на сигурност, FS	FS5; FS10	
Номинален вторичен ток, A	1; 5	
Мощност, VA	до 200	

3. **Типово означение:** PA 123a, PA 145a.

4. **Описание на местата, предназначени за поставяне на знаци от метрологичен контрол:**
   - Знакът за одобрен тип (марка за залепване) се поставя на табелката с технически данни;
   - Знакът за първоначална проверка (марка за залепване) се поставя до знака за одобрен тип.

„Доставка на електрически апарати 110kV“, реф. № PPD 17-064.

Обособена позиция 2 – Доставка на токови измервателни трансформатори 110kV за монтаж на открито – 21бр.

ПРИЛОЖЕНИЕ 3

ABB

Технически данни : Токов Трансформатор

дата :	**2017-06-20**	**Име :**	**bozena.trajer@pl.abb.com**
CCP Number:	**-**		
Наш реф. :	**KU 596/17**	**Ревизия :**	**A**
Проект :	**CEZ Bulgaria**		

Общи данни

Количество	21
Тип	PA 123a
Стандарти	IEC 61869-2
Монтаж	Открит
изолация	Масло / хартия херметичен
Производител, страна	ABB, Полша

Работни условия

Най-високо напрежение на с-мата (фаза-фаза) U_{sys}	kV r.m.s.	123
Номинална честота f_R	Hz	50
Температура на околната среда	°C	-40/ +40
Средна темп. На околната слреда (период 24ч)	°C ≤	35
Надморска височина	m	1000
Сеизмична активност съгл. IEC 62271-300		AF3

Номинално изолационно ниво

Най-високо напрежение за оборудването (фаза-фаза) U_m	kV r.m.s.	123
Обявено издържано напрежение с мълниев импулс 1,2/50 µs	kV peak	550
Обявено издържано напрежение с промишлена честота, сухо	kV r.m.s.	230
Обявено издържано напрежение с промишлена честота, мокро	kV r.m.s.	230

Отношения на тока

Номинален първичен ток I_{pr}	A r.m.s.	200 - 400 - 800
Ном. продължителен термичен ток I_{cth}	A r.m.s.	240-480-960
Ном. Краткосрочен термичен ток I_{th} / време	kA r.m.s./s	31,5-31,5-31,5/1
Номинален динамичен ток I_{dyn}	kA peak	80 - 80 - 80
Превключване		Първично 1:2:4

Класове на точност

Ядро №.	Клеми	отношение A / A	Точност	Rct75	Брой клемна кутия	Капак за пламбиране
1, 2	[x]S1-[x]S2	200-400-800/5	1-15VA 0,2S ext.120% FS5	-	1	-
3, 4	[x]S1-[x]S2	200-400-800/5	30VA 10P10	-	1	-

[x] – означава даден номер на ядрото

Данни за продукта

Оразмерителен чертеж		2GKA614717A0596;rev.A
Език на табелката Тип изолатор / цвят		български Композитен / сив
Мин. път на утечка	mm	4411
Мин. дъгово разстояния	mm	1174
Тип на първичните клеми		Al плоска шина 100x120 T=20 mm; 4xD=14/50x50mm
Тип на заземителните клеми		2 x ø14 / 45-60mm
Тип на вторичните клеми		Phoenix rail клемни блокове; пружинна връзка, тип ST 10
Кабелни уплътнения – клемна кутия No. 1		Без кабелни уплътнения;

Изпитано издържано FRнатоварване на първичните клеми	(Статично/Дин.)N	3600/5000
Боядисване (цвят)		
- Корпус над изолатора		Не е боядисан
- Корпус под изолатора		Не е боядисан
Общо тегло	kg	315
Тегло на маслото	kg	130
Тип на изолационното масло		Nynas Nytro 10XN – Inhibited Минерално изолационно масло съгл. IEC 60296
Опаковане		Вертикално-3-броя в дървена каса
Тегло на пратката	kg/3броя	1115
Размери на пратката	cm x cm x cm/3броя	242x106x263
Обем на пратката	m3/3броя	6,4

ABB

Data Schedule : Current Transformer

Date :	**2017-06-20**	**Name :**	**bozena.trajer@pl.abb.com**
CCP Number:	**-**		
Our ref :	**KU 596/17**	**Revision :**	**A**
Project :	**CEZ Bulgaria**		

General data		
Quantity		21
Type		PA 123a
Standards		IEC 61869-2
Design		Outdoor
Insulation		Oil / paper hermetic
Manufacturer, country		ABB, Poland
Service conditions		
Highest voltage of a system (phase-to-phase) U_{sys}	kV r.m.s.	123
Rated frequency f_R	Hz	50
Ambient air temperature (Temperature category)	°C	-40/ +40
Average ambient air temp. (period 24h)	°C ≤	35
Altitude	m	1000
Seismic activity acc. to IEC 62271-300		AF3
Rated insulation level		
Highest voltage for equipment (phase-to-phase) U_m	kV r.m.s.	123
Rated lightning impulse withstand voltage 1,2/50 µs	kV peak	550
Rated power-frequency withstand voltage, dry	kV r.m.s.	230
Rated power-frequency withstand voltage, wet	kV r.m.s.	230
Current ratings		
Rated primary current I_{pr}	A r.m.s.	200 - 400 - 800
Rated continuous thermal current I_{cth}	A r.m.s.	240-480-960
Rated short-time thermal current I_{th} / time	kA r.m.s./s	31,5-31,5-31,5/1
Rated dynamic current I_{dyn}	kA peak	80 - 80 - 80
Reconnection		Primary 1:2:4

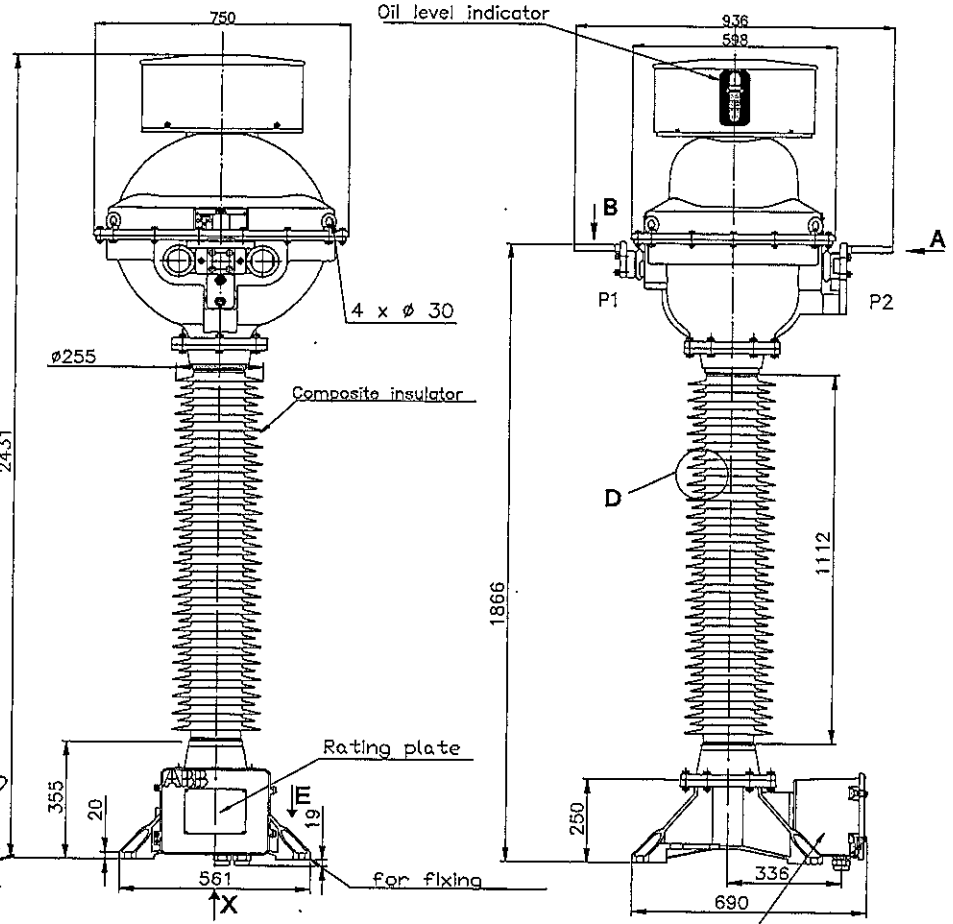
Accuracy ratings

Core No.	Terminals	Ratio A / A	Accuracy	Rct75	No. of terminal box	Cover for sealing
1, 2	[x]S1-[x]S2	200-400-800/5	1-15VA 0,2S ext.120% FS5	-	1	-
3, 4	[x]S1-[x]S2	200-400-800/5	30VA 10P10	-	1	-

[x] – means given number of the core

Product data		
Dimension drawing		2GKA614717A0596;rev.A
Rating plate language		Bulgarian
Insulator type / colour		Composite / grey
Minimum creepage distance	mm	4411
Minimum arcing distance	mm	1174
Primary terminal type		Al flat pad 100x120 T=20 mm; 4xD=14/50x50mm
Earthing terminals type		2 x ø14 / 45-60mm
Secondary terminal type		Phoenix rail terminal blocks; spring connection, type ST 10 without cable glands;
Cable glands – terminal box No. 1		

Withstand test load on primary terminal FR	(Static/Dyn)N	3600/5000
Painting (colour)		
- Housing above insulator		Not painted
- Housing below insulator		Not painted
Total weight	kg	315
Weight of oil	kg	130
Insulating oil type		Nynas Nytro 10XN – Inhibited mineral insulating oil acc. to IEC 60296
Packing		Vertical -3-pack wooden crate
Shipping weight	kg/3unit	1115
Shipping dimensions	cm x cm x cm/3unit	242x106x263
Shipping volume	m3/3unit	6,4



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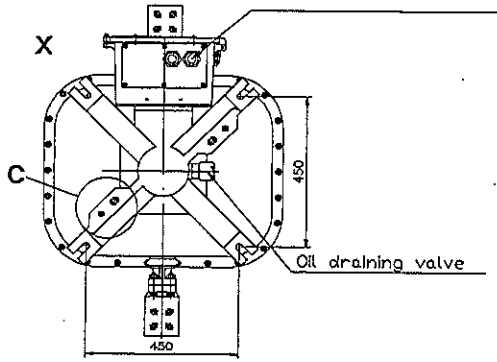

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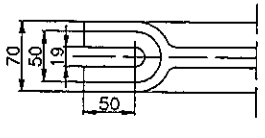
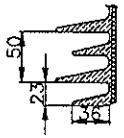
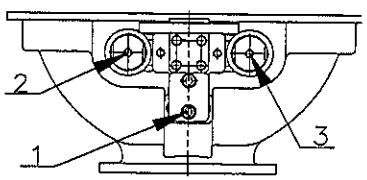
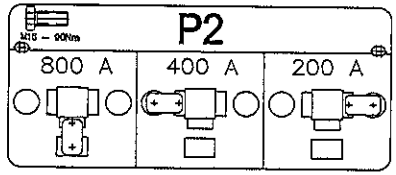


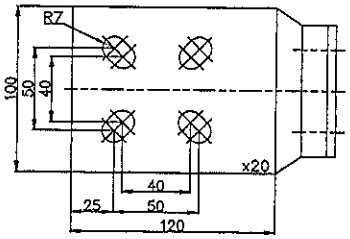




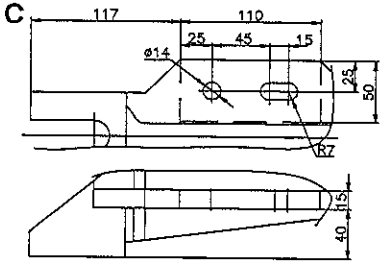


Flat terminals – Aluminium alloy

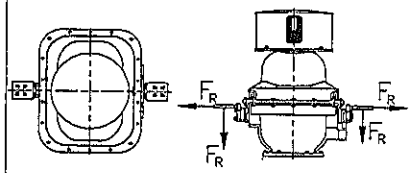
DIN 46206–3 F1



Earthing terminal



Mechanical load



Maximum operating voltage	(kV)	123
Total weight	(kg)	315
Insulating oil amount	(kg)	130
Wind pressure surface	(m^2)	0,65
Creepage distance	(mm)	4411

Mechanical load:

F_R – Static load	(kN)	3,6
F_R – Dynamic load	(kN)	5,0

Standard IEC 61869–2

Comments –

Order

Scale 1:15 | Units mm | Format A3

Prepared 22.06.2017 P.Mikulski

Based on –

Reviewed

Responsible department PGHV/PLABB/IT/TS

Approved 22.06.2017 J.Duzdowski

Document kind Drawing

ABB Technology Ltd

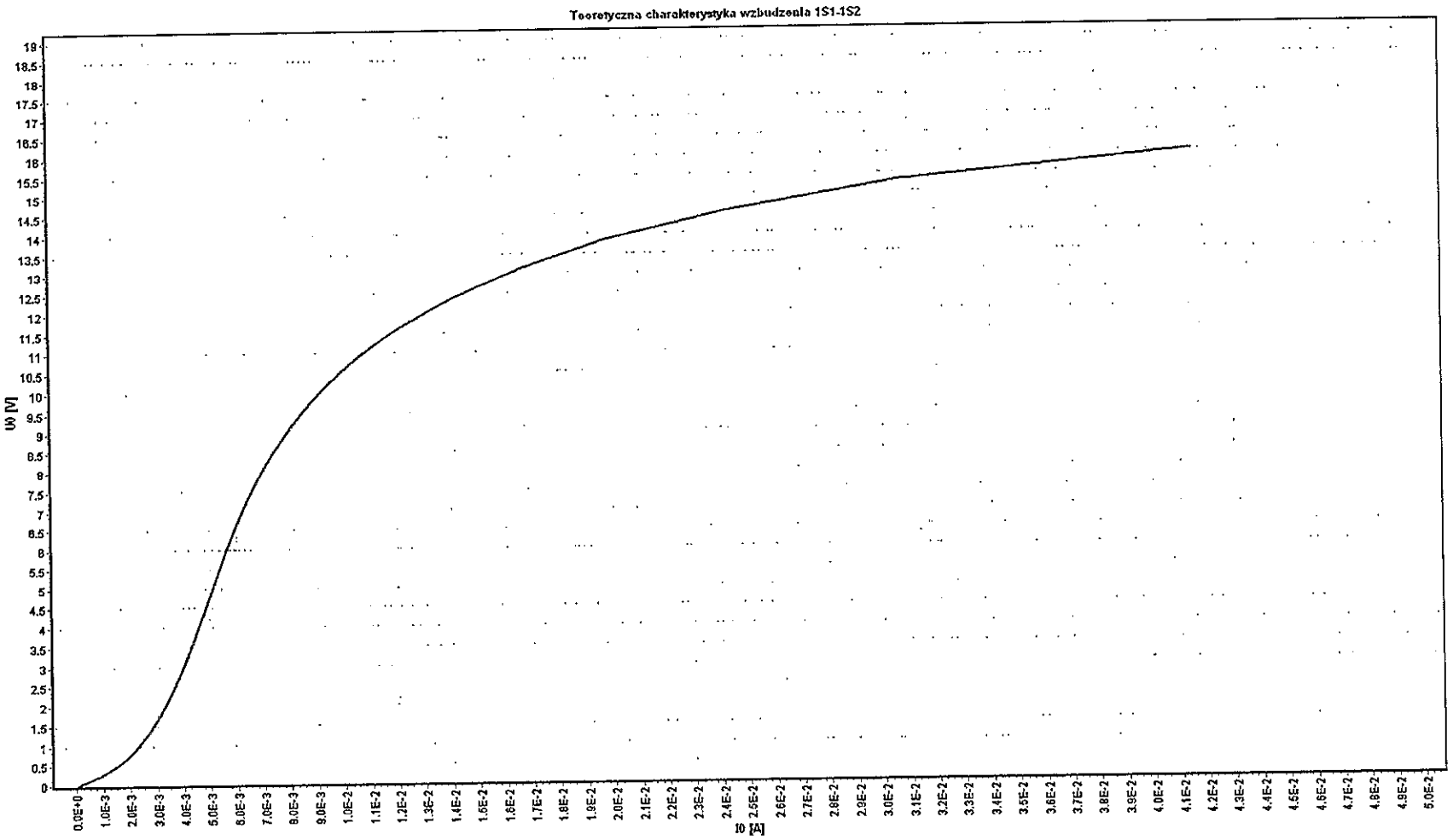
Title: Dimensional drawing Current transformer PA 123a

Language EN | Page 1

Document id. 2GKA614717A0596 | Revision A

KU596/17

1S1-1S2 = 2S1-2S2



3S1-3S2 = 4S1-4S2

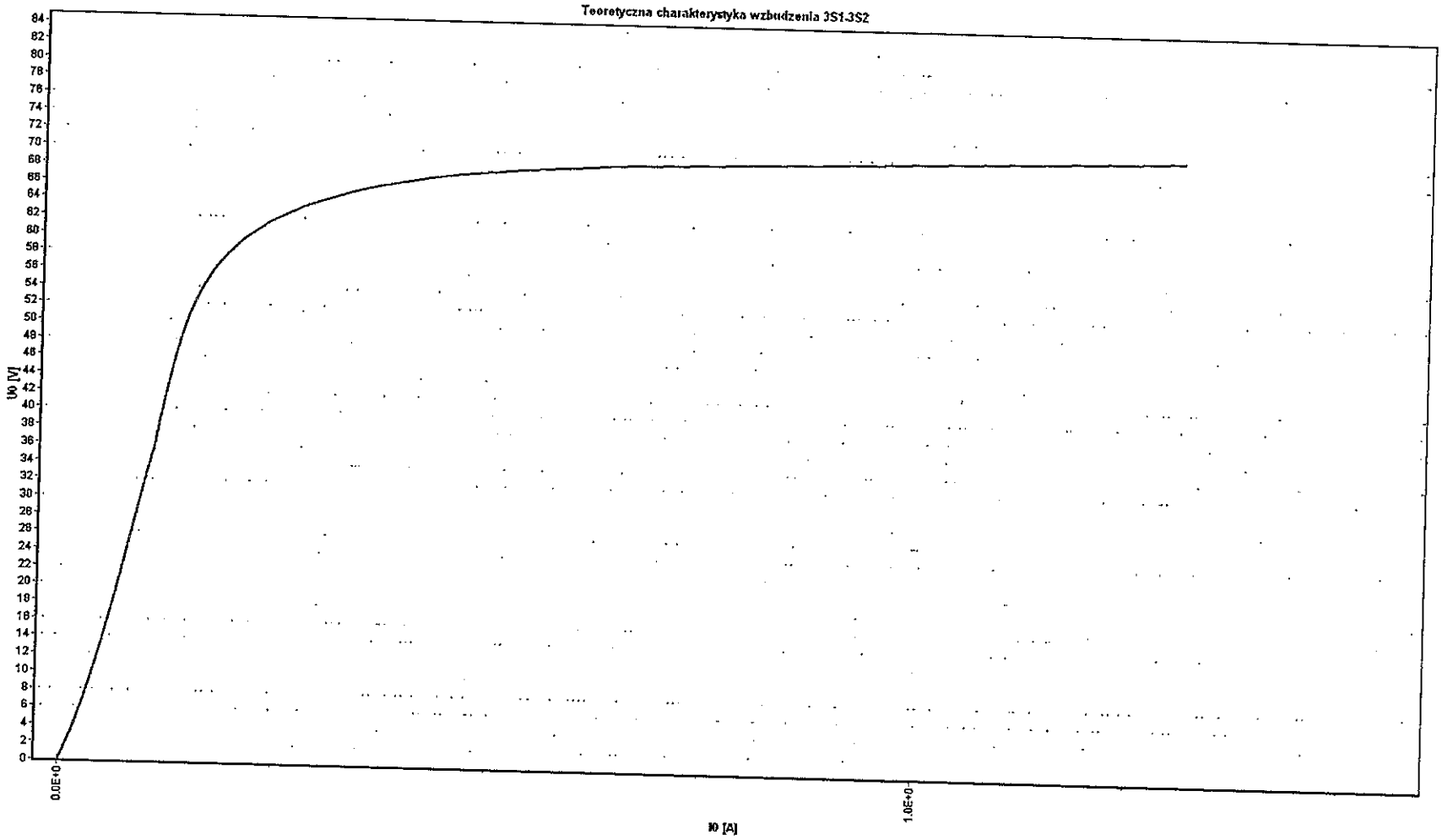


ABB Токов трансформатор

BG 14
5043

Тип PA 123a | Сериен № 2GGKAnnnnnnn | Производство година yyyy

Изолационно ниво 123/230/550 kV | Стандарт IEC 61869-2 | Темп. -40/40

Транспортиране Вертикално | f_R 50 Hz | F 3,6 kN | Клас изолация A

I_{th} 31,5-31,5-31,5 kA/1s | I_{dyn} 80-80-80 kA | I_{cth} 240-480-960

1S1-1S2	200-400-800/5A 1-15VA cl.0,2S ext.120% FS5
2S1-2S2	200-400-800/5A 1-15VA cl.0,2S ext.120% FS5
3S1-3S2	200-400-800/5A 30VA cl.10P10
4S1-4S2	200-400-800/5A 30VA cl.10P10

Тегло 315 kg | Тегло на маслото 130 kg

Тип на маслото Nynas Nytro 10XN ISO-L-NTIO-2960130

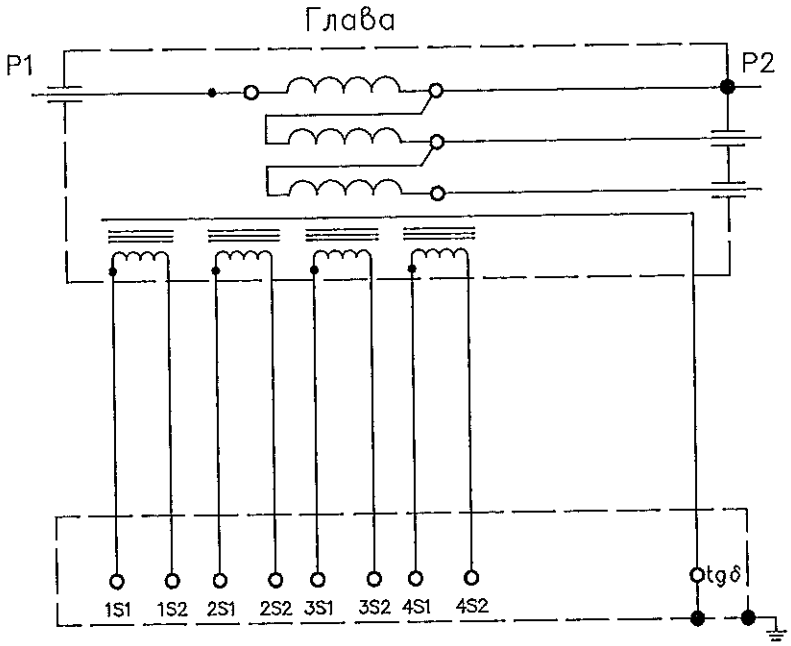
Внимание: Херметични устройство, не разпечата. Масло за вземане на проби в съответствие с инструкциите на производителя.

180

Serial number 2GGKAnnnnnnn
Production year yyyy = Actual year of production

Marking of the plate performed by laser engraving method.

Aluminium sheet: EN AW-5754(AlMg3) Material standard: EN 485-1/EN 573-3			Anodizing: ISO 7599 Layer thickness: 20µm
Material:			Coating: /
Prepared by:	P.Mikulski	Date: 22.06.2017	Replacement of: ------ Application: ------
			Name of item: Title:



Клемна кутия

Електрическа схема на измервателен трансформато

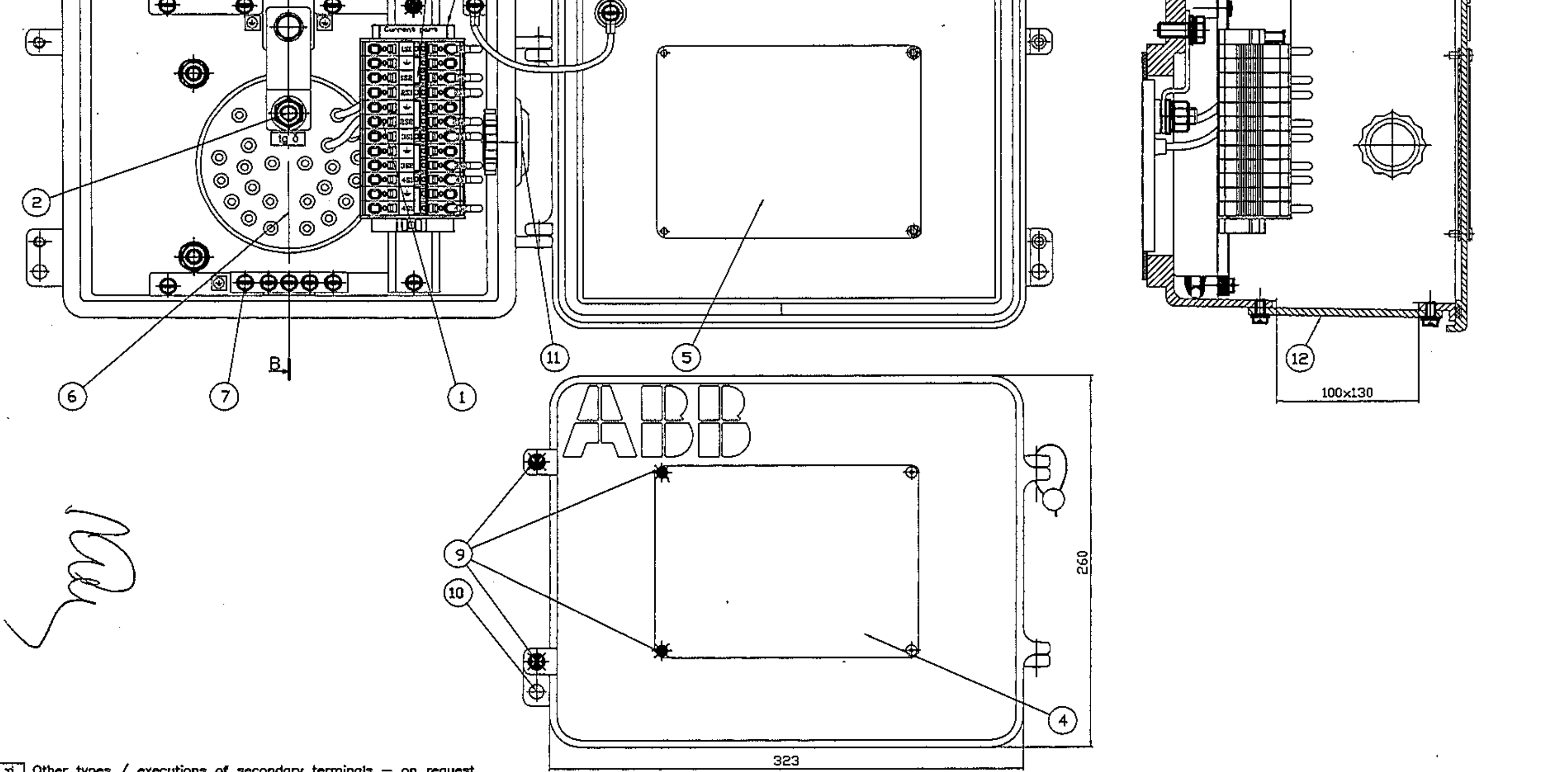
ВНИМАНИЕ!

1. ВИСОКО НАПРЕЖЕНИЕ ПРИ ОТВОРЕНИ ТОКОВИ ВТОРИЧНИ КЛЕМИ XS1 – XS2
2. ПО ВРЕМЕ НА РАБОТА НА ИЗМЕРВАТЕЛНИЯ ТРАНСФОРМАТОР КЛЕМА tgδ ТРЯБВА ДА БЪДЕ ЗАЗЕМЕНА

180

Marking of the plate performed by laser engraving method.

Aluminium sheet: EN AW-5754(AlMg3) Material standard: EN 485-1/EN 573-3			Anodizing: ISO 7599 Layer thickness: 20μm
Material:			Coating: /
Prepared by:	P.Mikulski	Date: 22.06.2017	Replacement of: ------ Application: ------



Other types / executions of secondary terminals — on request.

1. Current secondary terminals [we offer spring-cage feed-through terminals of Phoenix make type ST or screw connection type UT]
2. Current coil screen terminal "tg δ" [during normal operation it is earthed with jumper]
3. Earthing jumper [crosswise plug-in bridge]
4. Rating plate
5. Schematic diagram plate
6. Resin bushing
7. Earthing rail
8. ——————————
9. Screws used for sealing of terminal box
10. Locking [for padlock]
11. Ventilation valve
12. Cable panel [detachable]

Dimensions are given in mm.

Prepared	Date	Replacement of	
P.Mikulski	22.06.2017		
Modified by	Date	Responsible department PGHV	Title Secondary ter… of current tr…
Approved by J.Duzdowski	Date 22.06.2017	Take over department	
Revision A			
ABB	ABB Sp. z o.o. Power Grids		Document no. 2GKA7143…

High Voltage Products

Current Transformers PA 123a and PA 145a

Installation and operation manual

Your safety first!

This is the reason why our manual begins with the following guidelines:

- Use the transformer for its intended purpose.
- Observe the technical data given in the rating plate and in the specification.
- To facilitate the installation and ensure high quality standards, the installation should be carried out by specially trained personnel or supervised by the service department of ABB.
- Operations have to be carried out by specially trained electricians who are familiar with the following instructions.
- It is recommended to observe the standards (DIN VDE/IEC) and local OHS regulations, as well as the requirements of the local electric authority.
- Transformer work should be changed over in accordanc the instructions in the manual.
- All documentation should be available to all persons inv installation, maintenance and operation.
- Operating personnel shall bear all responsibility for all as related to the operational safety as stated in EN 50110 0105) and national regulations.
- Observe the safety rules, which are compliant with EN 5 (VDE 0105). This standard regards ensuring a no-voltag at the site for works to be carried out on the transforme

If you have any questions regarding the information conta this manual, our organisation will provide the necessary in tion.

Important information

This manual is intended to explain the mode of operation and installation of the product.

NOTE:
All descriptions contained in this document are for general information only and do not make consideration for specific design requirements. Please refer to the exact design documentation while connecting the device.

Operating the device without first reading the manual may entail property damage, serious injury or death. The person responsible for the installation of the device should read the following instructions and follow the recommendations contained herein.

For your own safety:

- Make sure that all installation, service and maintenance works are carried out by professionals.
- Make sure that all applicable regulations will be preserv ring all the work phases (installation, service, maintenan
- Make sure that the guidelines contained in this manual a followed.

Basic guidelines for this manual

Read the relevant chapters of this manual to provide adeq work.

Chapters in this manual are marked according to their mea

For the purposes of this manual, failure to fol the instructions concerning the dangers coul result in death, serious injury and damage of equipment.

Table of Contents

Current Transformers PA 123a and PA 145a

1. Introduction

The subject of this manual are type PA 123a and PA 145a overhead current transformers. These transformers are used for feeding measurement and protection systems in power networks with maximum system voltage of 123 kV and 145 kV or lower (the greatest effective value of phase-to-phase voltage) and 50 Hz frequency. They are designed for operation in power systems with earthed or insulated neutral points as well as in compensated networks.

2. Delivery of transformer

Typically, the transformers are delivered in bulk packaging (3 pcs) where they are stacked vertically. The packaging is in the form of a complete crate. The delivered transformers are fully assembled, tested and ready for direct use. Product test protocols are delivered together with the transformers.

Immediately after the delivery, check the transformer for any transport damage. Check the transport packaging. A damaged packaging may indicate a careless handling of the transformer. Then, check the transformer. Special attention should be paid to possible damage of sheds and binder at insulator flanges, the transformer tightness and the correct oil level indication in the device. One should ensure that technical parameters of the transformer given in the rating plate are in accordance with the parameters given when submitting the order and in accordance with the design documentation parameters.

Any damage or other defects should be immediately notified to the manufacturer and, if appropriate, the carrier. Photos will be helpful for any damage assessment.

3. Transportation, unpacking, lifting

Transformers should be transported in a vertical position. Transformers should be transported in accordance with transport manual No 2GKA612015.

Transformers should be transported in wooden complete crates, 3 pcs in each. Due to the high centre of gravity, transformers must be additionally protected with boards attached at the level of the head.

4. Storage

Transformers should be stored on a levelled and hardened ce, preferably in the original packaging. In the case of long storage, it is recommended to protect contact surfaces ag corrosion.

Transformers can be stored in the open air for up to two ye this period is exceeded, it is recommended to place transf in a well-ventilated room or under a roof, and to insert silica another moisture absorbent into terminal boxes.

5. Installation

The support structure should be flat and horizontal. The lev correction can be carried out using shims placed between transformer and the support structure. Provisions of the tra manual No 2GKA612015 should be followed while erecting the transformer. Use bolts of correct size for fastening the tr mer to the support structure. The support structure and fas elements are not included in the delivery. The transformer sh be placed in the vertical position at least 24 h before energis

5.1. Earthing terminals

Two earthing terminals are located diagonally in the bottom Prior to connection, the contact surface of the terminals sho be thoroughly cleaned from the oxide layer so it becomes ur and smooth. Additionally, a thin layer of conducting grease c be applied in order to improve contact. The earthing should connected using stainless bolts.

5.2. Primary terminals

Primary terminals of the transformer, marked as P1 and P2, a placed on the opposite sides of the head. The transformer ca switched on the primary side as well as on the secondary sid metal jumper is used for current range switching on the prima side.

The primary winding should be switched to the required curre range by locating a moving jumper, fastened with two M16 bo in the respective position.

Note:
Jumper tightening torque 90 Nm

Current range jumper positions are shown on the rating plate.

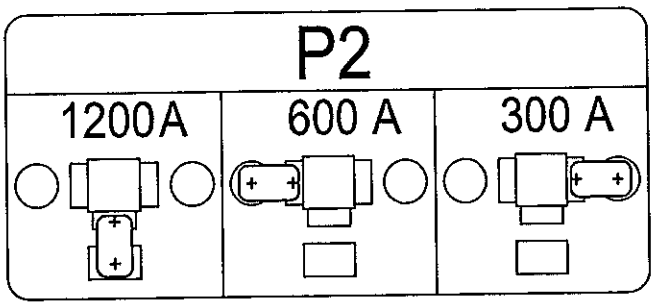


Fig. 1. Example: Rating plate with current range jumper positions.

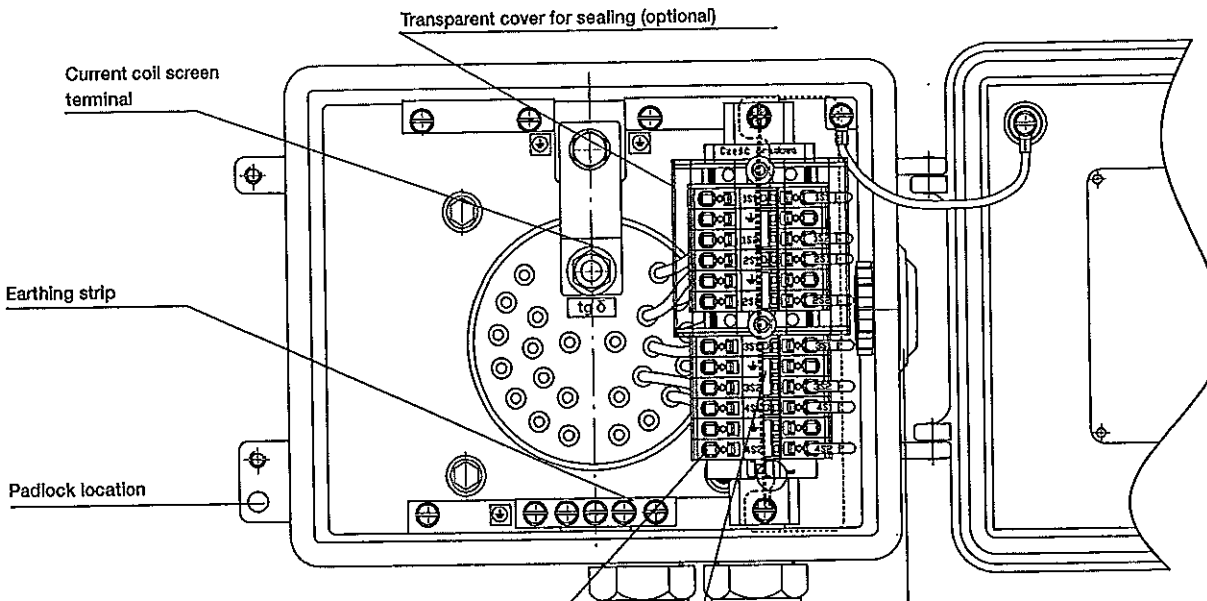
All contact surfaces of the primary terminals should be even and cleaned from the oxide layer before connecting. In the case of copper terminals, use of extraction naphtha is usually sufficient. Conducting grease can be applied in order to improve contact. Use M10 bolts (stainless steel is recommended) to connect wire lugs with the terminals. Incorrect primary connection could induce the transformer to overheat, which can cause failures. Primary connections should be made in such a way so as to minimise mechanical static loads of the transformer terminals. The maximum allowable static load of each transformer terminal is equal to 3,600 N in any direction. Only one terminal may be loade such force at a time.

5.3. Secondary terminals

Secondary windings are connected to terminal blocks in th nal box on the bottom tank of the transformer. These are ty Phoenix Contact ST spring connectors with terminals adap connection of cables of cross-section up to 10 mm^2 or up 6 mm^2. Each terminal is described in compliance with the markings given on the rating and schematic diagram plate Yellow-green terminals (with the earthing mark) are intende earthing the secondary windings with the use of push-in cr bridges. The crosswise bridge can be removed with a scre by inserting it in the slit and levering.

Optionally, the connectors to which metering windings are may be adapted for sealing with the use of a transparent c The current coil screen is led out with a pin through the res hing (tg δ terminal).

A rating plate is placed on the external side of the door, wh schematic diagram plate is placed inside. The plate with h the secondary circuit wire glands is located on the termina bottom wall. Typically, they are two M40 glands with the cl range of Φ 19–28 mm. An example of a terminal box for s dary windings of the transformer is shown in Figure 2.



Connect external circuits to secondary terminals of the current module of the transformer pursuant to the wiring shown on the schematic diagram plate and in accordance with the design documentation.
The current coil screen terminal (tg δ) should be earthed with a jumper during normal transformer operation.
Connectors inside the terminal box are arranged so that, when using crosswise bridges, earthing is possible for any secondary terminal of a given winding.
Transformer with taps on the secondary side:
- In the case of a transformer with the secondary side switching option, the unused taps must remain unearthed. Only connect the earthing to one of the terminals, which are connected with the external circuit for the selected secondary winding.

Unused windings:
- The first and the last terminals (for the secondary side switching option: those terminals correspond to the highest transformer ratio) of the unused secondary winding should be connected with each other (minimum wire size: 6 mm^2) and earthed with a crosswise bridge. Each unused winding should be earthed in one point only.

Note:
Opening the current module secondary circuit in the standard operation mode causes high voltage on terminals of this circuit. This is hazardous to the staff and may damage the transformer insulation.

6. Bolt tightening torques

Primary terminal bolts M10	40 Nm
M16 Bolts fastening the jumper	90 Nm
Bolts fastening the transformer to the support structure	280 Nm

7. Operation and maintenance

Note:
Combined transformers are HV devices, hence appropriate safety precautions shall be observed during their operation. The transformer measurement range is only guaranteed within the operating range determined based on the ratings in compliance with the respective standards. The standard number is shown on the transformer rating plate. The measurement range of the transformer is also shown in the product test protocol as delivered with the transformer. The measurement parameters are not guaranteed off that range.

7.1. Operation
The combined transformers do not require any special m
ce procedures. Visual inspection is usually sufficient. The
is included at the end of this manual.

Visual inspection
The visual inspection should include the checking of:
- position of the oil level indicator,
- tightness of the transformer,
- lack of mechanical damage,
- condition of the insulator and binder connecting the ins
  with flanges.

From time to time, primary terminals torque should be che
The transformer tightness is of a particular importance as
could penetrate the device in the case of oil leaks.

Oil level indicator:
Changes of the oil level indicator position depend on oil te
rature in the transformer. The indicator should remain withi
green field range. Shifting of the indicator to the upper or b
red field points out to an incorrect transformer operation. In
case, the transformer should be put out of service, and the
facturer should be contacted.
On the lid covering the head stainless steel expansion bellc
are placed, used for compensation of oil volume thermal ch
in the transformer. The oil level indicator (2) is placed on the
surface of the bellows. The bellows is seated in a metal hou
(3) equipped with a window (4). Cover removal does not res
unsealing of the transformer. The whole compensation syst
shown in Figure 3.

Note:
Oil level indication for all three transformers installed
adjacent phases should be almost equal.

Measurement of the dielectric loss factor tg δ:
During measurement of the dielectric loss factor tg δ, the me
ring bridge should be connected to the correct terminal mark
with the tg δ symbol, after the previous removal of the earthi
jumper from this terminal. Remember to earth the terminal ag
after the measurement. Typically, the test voltage should be 1
RMS and should be applied between the closed primary tern
and terminal tg δ.

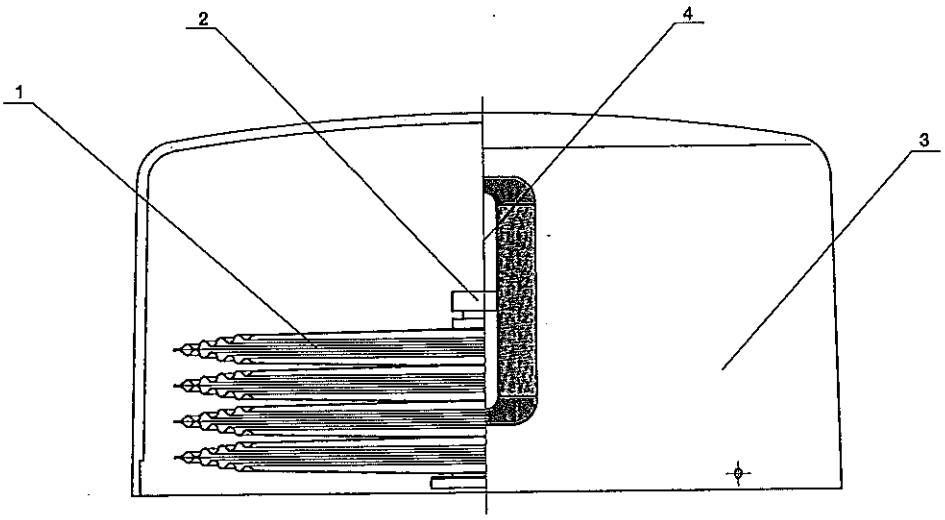


Fig. 3. Construction of the compensation system

Oil sampling:

Due to the fact that transformers are airtight, they do not require periodical oil checking. Oil used in the transformer meets the requirements of PN-EN 60296 (IEC 60296). Oil check is recommended after 15–20 years of operation or after a fault, if any suspicion as to the transformer efficiency exists.

Contact the manufacturer in order to obtain necessary instructions for the oil sampling procedure. Oil sampling without the manufacturer's permission during the guarantee period is the reason for the guarantee cancellation.

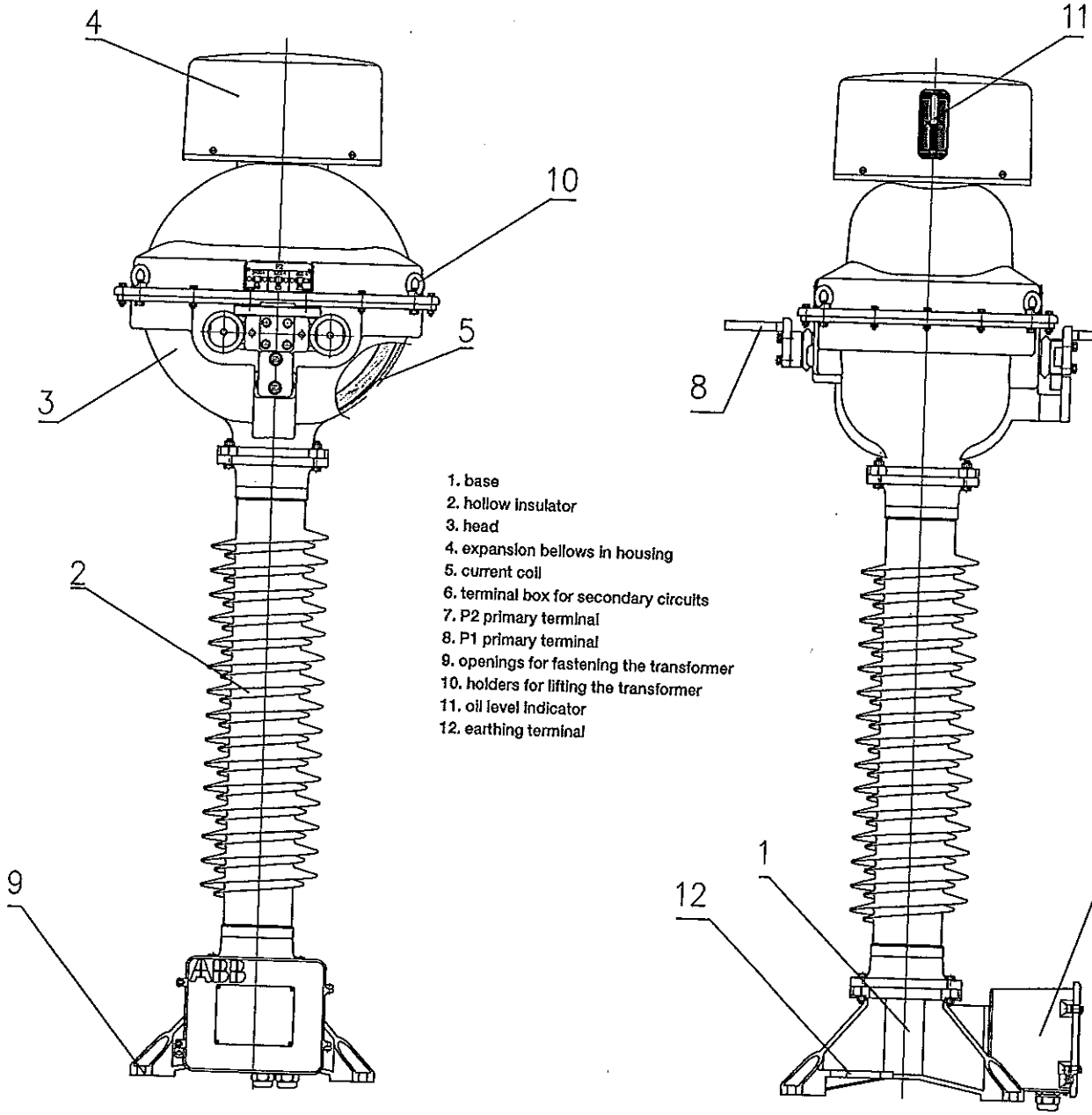
7.2. Corrosion protection

External components of the transformer casing are made of corrosion-proof cast aluminium alloy. Casts can be unpainted or painted. Standard colours for the paint coat: light-grey (RAL 7035), grey-green (RAL 7033). The remaining metal elements, such as bolts, are made of stainless steel.

Position of the oil level indicator	Interp
Indicator in the green area	Correct operation of the tra
Indicator on the upper red field	Oil pressure
	Transformer ov
	Oil gasification (insulatic
	Further inspection n
Indicator on the lower red field	Oil leve
	Suspicion of oil leakage (mois
	penetra
	Further inspection n

8. Structure of the transformer

PA 123a and PA 145a type current transformers comprise
rent coil in tight casing filled with transformer oil.
This is a "top core" type structure, where the magnetic tor
res are located in the transformer head. The cores with se
windings are additionally encapsulated in a metal can con
via a tube to terminal box tg δ terminal. Both the metal ca
well as the tube are insulated with oil impregnated electric
paper.



1. base
2. hollow insulator
3. head
4. expansion bellows in housing
5. current coil
6. terminal box for secondary circuits
7. P2 primary terminal
8. P1 primary terminal
9. openings for fastening the transformer
10. holders for lifting the transformer
11. oil level indicator
12. earthing terminal

Fig. 4. Structure of PA 123a and PA 145a current transformers

The distribution of electric stresses in the paper insulation is capacitor controlled. An exterior screen is located external to the coil, connected to the primary terminal inside the head.
External insulation comprises a hollow insulator made out of electrical porcelain with brown enamel or a glass reinforced plastic (FRP) tube coated with grey silicon rubber. O-ring seals are made of NBR oil-resistant rubber.
If calibration of measuring windings has been performed, respective marking (designations) have been placed on the transformer and the rating plate (where required).

9. Recycling and disposal

During correct operation and if no mechanical damage occurs, the transformer should operate over 30 years. Once this period of time has expired or if the operation is no longer required, it is recommended to dispose of the transformer.

Primary materials used in the transformer:

No	Material	Quan
1	Copper (Cu – ETP)	
2	Aluminium alloy AC-Al Si10Mg (Cu)	
3	Steel	
4	Transformer sheet steel	
5	Permalloy (iron-nickel alloy)	
6	Mineral transformer oil	
7	Electrical grade paper	
8	Solid insulation materials (epoxy resin, bakelite paper)	
9	Porcelain	
10	Composite insulator	

Items 9 and 10 alternatively.
The above values are approximate.

9.1. Recycling and disposal proceedings

Recycling and disposal should meet national (or local) regu
On the territory of the Republic of Poland, the transformer
procedure is defined in "The Waste Act" ("Ustawa o odpad
of 14 December 2012, as published in Journal of Laws iter
21/2013, as amended.

For more information please contact:

ABB Contact Center
Phone: +48 22 22 37 777
e-mail: kontakt@pl.abb.com

ABB Sp. z o.o.
Branch Office in Przasnysz
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instytut.energetyki@ien.com.pl

AC 117

СЕРТИФИКАТ ЗА СЪОТВЕТСТВИЕ

№ 079/2014
Издание №2 от 05.03.2015

Име и адрес на притежателя на сертификата:	ABB Sp. z o.o. ул. Зеганска 1 04-713 Варшава, Полша
Име на продукта:	Токов трансформатор
Тип:	PA 123a
Производител:	ABB Sp. z o.o. клон в Пшашниш ул. Лешно 59 06-300 Пшашниш, Полша
Параметри и приложение на продукта:	Съгласно Приложение Токов трансформатор, предназначен за мон открито, в електрически мрежи с номинални напрежения 110 kV
Продуктът отговаря на изискванията на:	IEC 61869-1 изд. 1.0 (2007) и IEC 61869-2 изд. 1.
Според доклада, изработен от:	Институт по енергетика
Номер на доклада за оценка:	DZC/135c/E/2014-1
Период на валидност:	от Ноември 2014 г. до Ноември 2017

Правото на използване на сертификата за съответствие, в рамките на срока на валидност, важи само за:

- тези копия, които отговарят на изискванията, посочени по-горе и имат съ характеристики (параметри), като модела/продукта представен за изпитания,
- притежателя на сертификата или негов оторизиран представител.

Приложението към сертификата за съответствие, включва списъка с доказани параметри,

AC 117

ПРИЛОЖЕНИ КЪМ СЕРТИФИКАТ ЗА СЪОТВЕТСТВ
№ 079/2014
Издание №2 от 05.03.2015
СПИСЪК НА ДОКАЗАНИТЕ ПАРАМЕТРИ

Токов трансформатор тип PA 123a	
Макс. напрежение на токовия трансформатор [U_m]	≤ 123 kV
Номинална честота [f_R]	50 Hz
Номинално изолационно ниво	AC 230 kV / LI 550 kV
Клас на натоварване	F_R=3600N
Външна изолация – път на утечка на изолатора - порцеланов изолатор - композитен изолатор	 3640 mm 3800 mm
Степен на защита от механично въздействие на обвивката [1)]	IK7
Степен на защита на вторичната клемна кутия	IP55
Токова част	
Номинален първичен ток [I_{pn}]	50 A ÷ 3000 A
Разширен токов обхват	до 200%
Номинален продължителен ток на термична устойчивост [I_{cth}]	≤ 3000 A
Номинален ток на термична устойчивост [I_{th}], 1s	20 kA или 40 kA или 63 k
Номинален ток на термична устойчивост [I_{th}], 3s	20 kA или 40 kA
Номинален ток на динамична устойчивост [I_{dyn}]	50 kA или 100 kA или 158
Номинален вторичен ток [I_{cth}]	1 A или 5 A
Номинална мощност на намотките за мерене и за защита (S_r)	1 VA – 200 VA
Клас на точност на намотките за мерене (кл.)	0,1; 0,2; 0,2S; 0,5; 0,5S; 1; 3
Клас на точност на намотките за защита (кл.)	5P, 10P, 5PR, 10PR, PX, PXR,TPX, TPY, TPZ

ЗАБЕЛЕЖКА:
[1)] Не е приложимо е за порцеланови изолатори.

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AC 117

CERTIFICATE OF CONFORMITY

No. 079/2014

Issue No. 02 from 05.03.2015 r.

Name and address owner of certificate:	ABB Sp. z o.o. 1 Żegańska Str. 04-713 Warszawa, Poland
Name of the product:	Current transformer
Type:	PA 123a
Manufacturer:	ABB Sp. z o.o. Branch Office in Przasnysz 59 Leszno Str. 06-300 Przasnysz, Poland
Parameters and application of product:	According to appendix Outdoor current transformer assigned for power systems of rated voltages 110 kV
The product meets requirements of the:	IEC 61869-1 ed. 1.0 (2007) and IEC 61869-2 ed. 1.0 (2012)
According to the report made by:	Instytut Energetyki
Number of the assessment report:	DZC/135c/E/2014-1
Period of validity:	from November 2014 until November 2017

The right to use the certificate of conformity within its validity period applies only to:

- these copies that meet the requirements specified above and have the same characteristics (parameters) as the model / product samples submitted for testing,
- certificate owner or his authorized representative.

The appendices to certificate of conformity including the list of evidenced parameters.
Number of appendices: 1

The system of product certification 1a (PN-EN ISO/IEC 17067:2014-01) includes:

- tests and quality assessment of project

pp of the DIRECTOR OF

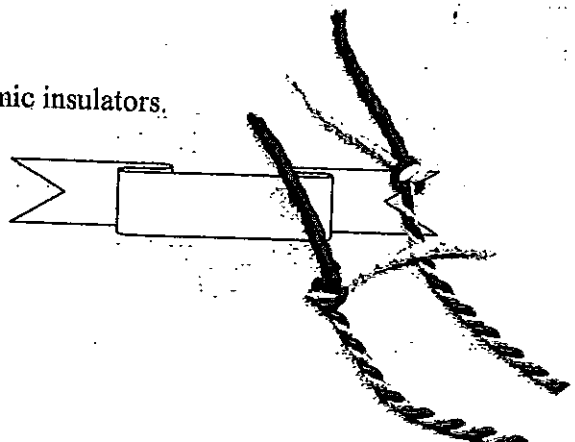
AC 117

APPENDIX TO CERTIFICATE OF CONFORMITY
No. 079/2014
Issue No. 02 from 05.03.2015 r.
LIST OF EVIDENCED PARAMETERS

Current transformer type PA 123a	
Highest voltage of current transformer [U_m]	≤ 123 kV
Rated frequency [f_R]	50 Hz
Rated insulation level	AC 230 kV / LI 550 kV
Burden class	F_R=3600N
External insulation – minimal creepage distance of insulator: • Ceramic insulator • Composite insulator	 3640 mm 3800 mm
Degree of protection to mechanical impact of enclosure [1)]	IK7
Degree of protection of secondary terminal enclosure	IP55
Current element	
Rated primary current [I_{pr}]	50 A ÷ 3 000 A
Extended current rating	to 200%
Rated continuous thermal current [I_{cth}]	≤ 3000 A
Rated short-time thermal current [I_{th}] during 1 s	20 kA or 40 kA or 63kA
Rated short-time thermal current [I_{th}] during 3 s	20 kA or 40kA
Rated dynamic current [I_{dyn}]	50 kA or 100 kA or 158 kA
Rated secondary current [I_{sr}]	1 A or 5 A
Core power to measurements and to protection (S_r)	1VA – 200 VA
Measure core accuracy class (kl.)	0,1; 0,2; 0,2S; 0,5; 0,5S; 1; 3; 5
Protective core accuracy class (kl.)	5P; 10P; 5PR; 10PR; PX; PXR; TPX; TPY; TPZ

NOTES:

1) Do not apply to ceramic insulators.



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	No previous validation
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ification of the substance/mixture and of the company/undertaking

Nytro 10 XN
Insulating oil
Liquid.
Oils

ubricants- Industrial n and closed systems - Professional ce - Industrial cking of substances and mixtures - Industrial nce - Industrial ustrial fessional

:	Reason
be used in applications other than those on 1, without first seeking the advice of the	-

r of the safety data sheet

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ie number
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24 hour service

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition: Mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]
Asp. Tox. 1, H304
Aquatic Chronic 3, H412

The product is classified as hazardous according to Regulation (EC) 1272/2008 as amended.
See Section 16 for the full text of the H statements declared above.
See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Hazard pictograms

Signal word: Danger

Hazard statements:
H304 - May be fatal if swallowed and enters airways.
H412 - Harmful to aquatic life with long lasting effects.

Precautionary statements

Prevention: P273 - Avoid release to the environment.

Response: P301 - IF SWALLOWED:
P310 - Immediately call a POISON CENTER or physician.
P331 - Do NOT induce vomiting.

Storage: Not applicable.

Disposal: P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles: Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII: Not applicable.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII: Not applicable.

SECTION 3: Composition/information on ingredients

3.2 Mixtures: Mixture

Product/ingredient name	Identifiers	%	Classification Regulation (EC) No. 1272/2008 [CLP]	Type
Distillate (petroleum), hydrotreated light naphthenic	REACH #: 01-2119480375-34 EC: 265-156-6	>99	Asp. Tox. 1, H304	[1]

omposition/information on ingredients

	01-2119555270-46 EC: 204-881-4 CAS: 128-37-0		Aquatic Chronic 1, H410 See Section 16 for the full text of the H statements declared above.	

to the base oil(s) in this product. Nota L - The classification as a carcinogen need not apply if it substance contains less than 3 % DMSO extract as measured by IP 346.
ingredients present which, within the current knowledge of the supplier and in the ble, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been exposure limit and hence require reporting in this section.

l with a health or environmental hazard
rkplace exposure limit
e criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
e criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
lent concern

st aid measures

id measures

Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If irritation, blurred vision or swelling occurs and persists, obtain medical advice from a specialist.

If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. If casualty is unconscious and: If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if adverse health effects persist or are severe. Maintain an open airway.

Wash with soap and water. Remove contaminated clothing and shoes. Handle with care and dispose of in a safe manner. Seek medical attention if skin irritation, swelling or redness develops and persists.

Accidental high pressure injection through the skin requires immediate medical attention. Do not wait for symptoms to develop.

Always assume that aspiration has occurred. Do not induce vomiting. Can enter lungs and cause damage. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Seek professional medical attention or send the casualty to a hospital. Do not wait for symptoms to develop.

Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.

oms and effects, both acute and delayed

cts

Eye contact may cause redness and transient pain.

Inhalation of oil mist or vapours at elevated

SECTION 4: First aid measures

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician	No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.
Specific treatments	Always assume that aspiration has occurred.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	Use dry chemical, CO_2, water spray (fog) or foam.
Unsuitable extinguishing media	Do not use direct water jets on the burning product; they could cause splattering and spread the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

5.2 Special hazards arising from the substance or mixture

Hazards from the substance or mixture	In a fire or if heated, a pressure increase will occur and the container may burst. This substance will float and can be reignited on surface water. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.
Hazardous thermal decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

5.3 Advice for firefighters

Special precautions for fire-fighters	Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
Special protective equipment for fire-fighters	Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Avoid breathing vapour or mist. Keep non-involved personnel away from the area of spillage. Alert emergency personnel. Except in case of small spillages, the feasibility of any actions should always be assessed and advised, if possible, by a trained, competent person in charge of managing the emergency. Stop leak if safe to do so. Avoid direct contact with the product. Stay upwind/keep distance from source. In case of large spillages, alert occupants in downwind areas. Eliminate all ignition sources if safe to do so. Spillages of limited amounts of product, especially in the open air when vapours will be usually quickly dispersed, are dynamic situations, which will presumably limit the exposure to dangerous concentrations. Note : recommended measures are based on the most likely spillage scenarios for this material; however, local conditions (wind, air temperature, wave/current direction and speed) may significantly

ental release measures

rs Small spillages: normal antistatic working clothes are usually adequate.

Large spillages: full body suit of chemically resistant and thermal resistant material should be used. Work gloves providing adequate chemical resistance, specifically to aromatic hydrocarbons. Note : gloves made of PVA are not water-resistant, and are not suitable for emergency use. Safety helmet, antistatic non-skid safety shoes or boots. Goggles and /or face shield, if splashes or contact with eyes is possible or anticipated.

Respiratory protection : A half or full-face respirator with filter(s) for organic vapours (and when applicable for H2S) a Self Contained Breathing Apparatus (SCBA) can be used according to the extent of spill and predictable amount of exposure. If the situation cannot be completely assessed, or if an oxygen deficiency is possible, only SCBA's should be used.

tions Water polluting material. May be harmful to the environment if released in large quantities. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Prevent product from entering sewers, rivers or other bodies of water. If necessary dike the product with dry earth, sand or similar non-combustible materials. In case of soil contamination, remove contaminated soil and treat in accordance with local regulations.

In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents.

If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities.

l for containment and cleaning up

Stop leak if without risk. Absorb spilled product with suitable non-combustible materials.

Large spillages may be cautiously covered with foam, if available, to limit vapour cloud formation. Do not use water jet. When inside buildings or confined spaces, ensure adequate ventilation. Transfer collected product and other contaminated materials to suitable containers for recovery or safe disposal. Note: see Section 1 for emergency contact information and Section 13 for waste disposal. See Section 8 for information on appropriate personal protective equipment.

See Section 1 for emergency contact information.
See Section 8 for information on appropriate personal protective equipment.
See Section 13 for additional waste treatment information.

dling and storage

ection contains generic advice and guidance. The list of Identified Uses in Section 1 should be le use-specific information provided in the Exposure Scenario(s).

Obtain special instructions before use. Hazard of slipping on spilt product. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Use and store only outdoors or in a well-ventilated area.

Avoid release to the environment.

handling

SECTION 7: Handling and storage

Protective measures

Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Avoid contact with eyes, skin and clothing.

Prevent the risk of slipping. Take precautionary measures against static discharge. Avoid splash filling of bulk volumes when handling hot liquid product.

Avoid release to the environment.

Nota : See Section 8 for information on appropriate personal protective equipment. See section 13 for waste disposal information.

Advice on general occupational hygiene

Ensure that proper housekeeping measures are in place. Contaminated materials should not be allowed to accumulate in the workplaces and should never be kept inside the pockets. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash hands thoroughly after handling. Change contaminated clothes at the end of working shift. See also Section 8 for additional information on hygiene measures.

7.2 Conditions for safe storage, including any incompatibilities

Storage area layout, tank design, equipment and operating procedures must comply with the relevant European, national or local legislation. Storage area layout, tank design, equipment and operating procedures must comply with the relevant regional, national or local legislation. Storage installations should be designed with adequate bunds in case of leaks or spills. Cleaning, inspection and maintenance of internal structure of storage tanks must be done only by properly equipped and qualified personnel as defined by national, local or company regulations.

Store separately from oxidising agents.

Recommended materials for containers, or container linings use mild steel, stainless steel. Not suitable : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Compatibility should be checked with the manufacturer.

Keep only in the original container or in a suitable container for this kind of product. Keep container tightly closed and sealed until ready for use. Do not store in unlabelled containers. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Empty containers may contain harmful, flammable/combustible or explosive residue or vapours. Do not cut, grind, drill, weld, reuse or dispose of containers unless adequate precautions are taken against these hazards. Store locked up. Protect from sunlight.

7.3 Specific end use(s)

Recommendations Not available.

Industrial sector specific solutions Not available.

SECTION 8: Exposure controls/personal protection

The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

8.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
Oil mist	*[Air contaminant]* **Rozporzadzenie Ministra Pracy i Polityki Spolecznej (Dz.U. 2014 poz. 817) (Poland, 6/2014).** TWA: 5 mg/m³ 8 hours. Form: Inhalable fraction

posure controls/personal protection

oring

If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to appropriate monitoring standards. Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

name	Type	Exposure	Value	Population	Effects
), hydrotreated	DNEL	Long term Inhalation	5.4 mg/m³	Workers	Local

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

g

Mechanical ventilation and local exhaust will reduce exposure via the air. Use oil resistant material in construction of handling equipment. Store under recommended conditions and if heated, temperature control equipment should be used to avoid overheating.

easures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Wash contaminated clothing before reuse.

Recommended: Safety glasses with side shields.

4 - 8 hours (breakthrough time): nitrile rubber

Wear protective clothing if there is a risk of skin contact. Change contaminated clothes at the end of working shift.

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary.

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Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

ical and chemical properties

hysical and chemical properties

Liquid.

Light yellow

Odourless/Light petroleum.

Not applicable.

Not applicable.

nt -60°C

lling >250°C

SECTION 9: Physical and chemical properties

Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	Not available.
Vapour pressure	160 Pa @ 100 °C
Density	0.88 g/cm³ [15°C]
Solubility(ies)	Insoluble in water.
Partition coefficient: n-octanol/ water	Not available.
Auto-ignition temperature	>270°C
Decomposition temperature	>280°C
Viscosity	Kinematic (40°C): 0.076 cm²/s (7.6 cSt)
Explosive properties	Not available.
Oxidising properties	Not available.
DMSO extractable compounds for base oil substance(s) according to IP346	< 3%

SECTION 10: Stability and reactivity

10.1 Reactivity	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	Stable under normal conditions.
10.3 Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	Oxidising agent.
10.5 Incompatible materials	Keep away from extreme heat and oxidizing agents.
10.6 Hazardous decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure	Remarks
Distillate (petroleum), hydrotreated light naphthenic	LC50 Inhalation Dusts and mists	Rat - Male, Female	>5.53 mg/l	4 hours	EMBSI 1988a (similar material)
	LD50 Dermal	Rabbit	>5000 mg/kg	-	API 1982 (similar material)
	LD50 Oral	Rat	>5000 mg/kg	-	API 1986a (similar material)
2,6-di-tert-butyl-p-cresol	LD50 Dermal	Rat	>5000 mg/kg	-	Supplier's information
	LD50 Oral	Rat	>5000 mg/kg	-	Supplier's information

Conclusion/Summary No known significant effects

cological information

Result	Species	Score	Observation	Remarks
Skin - Non-irritant to skin.	Rabbit	0 to 0.8	24 to 72 hours	UBTL 1984e (similar material)
Eyes - Non-irritating to the eyes.	Rabbit	0.17 to 0.33	24 to 72 hours	UBTL 1984l (similar material)
Eyes - Redness of the conjunctivae	Rabbit	0.5	-	Supplier's information
Eyes - Iris lesion	Rabbit	0	-	Supplier's information
Eyes - Oedema of the conjunctivae	Rabbit	0.1	-	-

No known significant effects or critical hazards.

No known significant effects or critical hazards.

No known significant effects or critical hazards.

Route of exposure	Species	Result	Remarks
skin	Guinea pig	Not sensitizing	UBTL 1984j,k,l (similar material)

No known significant effects or critical hazards.

No known significant effects or critical hazards.

Test	Experiment	Result	Remarks
OECD 473 473 In vitro Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal Metabolic activation: with and without	Negative	-

No known significant effects or critical hazards.

Result	Species	Dose	Exposure	Remarks
Negative - Dermal	Mouse - Female	0.22 to 0.25 ml	78 weeks; Various	Doak, 1983, McKee, 1989 (similar material)

The base oil(s) in this product is based on an severely hydrotreated distillate. The product should not be regarded as a carcinogen.

No known significant effects or critical hazards.

Result	Species	Dose	Exposure	Remarks

SECTION 11: Toxicological information

Conclusion/Summary: No known significant effects or critical hazards.

Aspiration hazard

Product/ingredient name	Result
Distillate (petroleum), hydrotreated light naphthenic	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure: Not available.

Potential acute health effects

Eye contact: Eye contact may cause redness and transient pain.

Inhalation: Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.

Skin contact: No known significant effects or critical hazards.

Ingestion: May be fatal if swallowed and enters airways.

Potential chronic health effects

Product/ingredient name	Result	Species	Dose	Exposure
2,6-Di-tert-butyl-p-cresol	Chronic NOAEL Oral	Rat	25 mg/kg	28 days; 7 days per week

General: No known significant effects or critical hazards.

Carcinogenicity: The base oil(s) in this product is based on an severely hydrotreated distillate. The product should not be regarded as a carcinogen.

Mutagenicity: No known significant effects or critical hazards.

Teratogenicity: No known significant effects or critical hazards.

Developmental effects: No known significant effects or critical hazards.

Fertility effects: No known significant effects or critical hazards.

Other information: Not available.

Specific hazard

SECTION 12: Ecological information

12.1 Toxicity

Product/ingredient name	Result	Species	Exposure
Distillate (petroleum), hydrotreated light naphthenic	Acute LL50 >10000 mg/l	Aquatic invertebrates.	96 hours
	Acute LL50 >100 mg/l	Fish	96 hours
	Acute NOEL >100 mg/l	Algae	72 hours
	Chronic NOEL 10 mg/l	Aquatic invertebrates.	21 days
2,6-Di-tert-butyl-p-cresol	Acute EC50 0.61 mg/l	Daphnia - Magna	48 hours
	Acute IC50 >0.4 mg/l	Algae - Desmodesmus Subspicatus	72 hours
	Chronic NOEC 0.316 mg/l	Daphnia - Magna	21 days

Conclusion/Summary: Harmful to aquatic life with long lasting effects.

12.2 Persistence and degradability

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Distillate (petroleum), hydrotreated light naphthenic	-	-	Inherent
2,6-Di-tert-butyl-p-cresol	-	-	Not readily

Conclusion/Summary: Inherently biodegradable.

cological information

ame	$LogP_{ow}$	BCF	Potential
hthenic sol	2 to 6 5,1	<500 >500	low high

The product has a potential to bioaccumulate.

High mobility in soil predicted, based on log Kow > 3.0.

d vPvB assessment

Not applicable.

Not applicable.

cts

Insoluble in water. Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

sposal considerations

ection contains generic advice and guidance. The list of Identified Uses in Section 1 should be le use-specific information provided in the Exposure Scenario(s).

ethods

Where possible (e.g. in the absence of relevant contamination), recycling of used substance is feasible and recommended. This substance can be burned or incinerated, subject to national/local authorizations, relevant contamination limits, safety regulations and air quality legislation. Contaminated or waste substance (not directly recyclable): Disposal can be carried out directly, or by delivery to qualified waste handlers. National legislation may identify a specific organization, and/or prescribe composition limits and methods for recovery or disposal.

Yes.

gue (EWC)

	Waste designation
	mineral-based non-chlorinated insulating and heat transmission oils

The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

nsport information

egulations

ADR/RID	ADN	IMO/IMDG Classification	ICAO/IATA Classification
regulated.	Not regulated.	Not regulated.	Not regulated.
	-	-	-
	-	-	-

SECTION 14: Transport information

14.5 Environmental hazards	No.	No.	No.	No.
Additional information	-	-	-	-

14.6 Special precautions for user

Transport within user's premises: always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

14.7 Transport in bulk according to Annex I of MARPOL 73/78 and the IBC Code

Oils

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Annex XIV

None of the components are listed.

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles: Not applicable.

Other EU regulations

Seveso Directive

This product is not controlled under the Seveso Directive.

International lists

National Inventory

Australia	All components are listed or exempted.
Canada	All components are listed or exempted.
China	All components are listed or exempted.
Japan	All components are listed or exempted.
Malaysia	All components are listed or exempted.
New Zealand	All components are listed or exempted.
Philippines	All components are listed or exempted.
Republic of Korea	All components are listed or exempted.
Taiwan	All components are listed or exempted.
United States	All components are listed or exempted.

15.2 Chemical Safety Assessment: Complete.

er information

Not available.

hat has changed from previously issued version.

ADN = European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterway
ADR = The European Agreement concerning the International Carriage of Dangerous Goods by Road
ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
CMR = Carcinogen, Mutagen or Reproductive toxicant
CSA = Chemical Safety Assessment
CO_2 = carbon dioxide
DNEL = Derived No Effect Level
EC50 = Half maximal effective concentration
EUH statement = CLP-specific Hazard statement
IATA = International Air Transport Association
IC50 = Half maximal inhibitory concentration
IMDG = International Maritime Dangerous Goods
LC50 = Median lethal concentration
LD50 = Median lethal dose
PNEC = Predicted No Effect Concentration
PBT = Persistent, Bioaccumulative and Toxic
RID = The Regulations concerning the International Carriage of Dangerous Goods by Rail
REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006]
SCBA = Self-Contained Breathing Apparatus
SVHC = Substances of Very High Concern

the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

assification	Justification
	Calculation method Calculation method

H304 May be fatal if swallowed and enters airways.
H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.
H412 Harmful to aquatic life with long lasting effects.

Aquatic Acute 1, H400	ACUTE AQUATIC HAZARD - Category 1
Aquatic Chronic 1, H410	LONG-TERM AQUATIC HAZARD - Category 1
Aquatic Chronic 3, H412	LONG-TERM AQUATIC HAZARD - Category 3
Asp. Tox. 1, H304	ASPIRATION HAZARD - Category 1

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No previous validation

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dge, the information contained herein is accurate. However, neither the above-named bsidiaries, assumes any liability whatsoever for the accuracy or completeness of the ein.
tability of any material is the sole responsibility of the user. All materials may present unknown sed with caution. Although certain hazards are described herein, we cannot guarantee that s that exist.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Industrial

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Use in formulations in lubricants- Industrial (2,6-di-tert-butyl-p-cresol)
List of use descriptors	**Identified use name:** Use in formulations in lubricants- Industrial **Process Category:** PROC01, PROC02, PROC03, PROC04, PROC05, PROC08a, PROC08b, PROC09 **Substance supplied to that use in form of:** As such **Sector of end use:** SU03, SU10 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC02 **Market sector by type of chemical product:** PC17, PC24, PC25
Environmental contributing scenarios	
Health Contributing scenarios	
Number of the ES	Not applicable.
Industry Association	Not applicable.
Generic exposure scenario	Not applicable.
Processes and activities covered by the exposure scenario	Covers the use of formulated lubricants within closed or contained systems including incidental exposures during material transfers, operation of machinery/engines and similar articles, equipment maintenance and disposal of wastes.
Additional information	Industrial

Section 2 - Exposure controls

Product characteristics	solid Melting/Freezing Point (°C): 69.8
Concentration of substance in mixture or article	≤100%
Amounts used	Annual site tonnage 110 t/a
Frequency and duration of use	Continuous release(d/a): 300
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Receiving surface water flow is 18000 m³/d. Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Not applicable.
Technical conditions and measures at process level (source) to prevent release	% Release fraction to wastewater from process (initial release prior to RMM) 0.2 % Release fraction to air from process (initial release prior to RMM) 0.01 % Release fraction to soil from process (initial release prior to RMM) 0
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil	On-site wastewater treatment required. Ensure all waste water is collected and treated via a waste water treatment plant. Floors should be impervious, resistant to liquids and easy to clean.
Organisational measures to	Ensure operatives are trained to minimise exposures.

sure controls

res wage: Size of industrial sewage treatment plant (m3/d): 2000, Removal Efficiency (total)94 %

res ment: No special measures are required. General information, See section 13 for waste disposal information.

es very: See section 13 for waste disposal information.

ntrolling worker exposure for 0:

Melting/Freezing Point (°C): 69.8

ance: ≤100%

solid

Solid, medium dustiness

of: Exposure duration per day: 8 h (full shift).
Exposure duration per year: 230 d

nced: Respiratory (m³/d): 10

kers: The product should be handled at room temperature.

el se: No special measures required.

Handle only in a place with local exhaust ventilation (or other adequate ventilation).

to: Ensure operatives are trained to minimise exposures.

related to personal protection and hygiene

Wear protective clothing. See Section 8 of the safety data sheet (personal protective equipment).

re estimation and reference to its source

Not available.

eference to its source - Environment 2:

Used EUSES model.(v2.1).

Risk characterisation ratio (PEC/PNEC): <1

eference to its source - Workers: 1:

Used ECETOC TRA model (May 2010 release). (04/2010)

Risk characterisation ratio DNELs <1

ce to DU to evaluate whether he works inside the boundaries set

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Not available.
Health	Not available.

Environment	Not applicable.
Health	Wear protective gloves/protective clothing/eye protection/face protection. Wear respiratory protection. See Section 8 for information on appropriate personal protective equipment.

ostance or mixture

Mixture

Nytro 10 XN

Use as lubricant in open and closed systems- Professional (2,6-di-tert-butyl-p-cresol)

Identified use name: Use as lubricant in open and closed systems - Professional
Process Category: PROC01, PROC02, PROC03, PROC04, PROC05, PROC07, PROC08a, PROC08b, PROC09, PROC10, PROC11, PROC13
Substance supplied to that use in form of: As such
Sector of end use: SU22
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC08a, ERC08d, ERC09a, ERC09b
Market sector by type of chemical product: PC17, PC24

ng

arios

	Not applicable.
	Not applicable.
rio	Not applicable.
	Covers the use of formulated lubricants in closed and open systems including transfer operations, operation of engines and similar articles, reworking on reject articles, equipment maintenance and disposal of waste oil.
	Professional

ure controls

	solid Melting/freezing point 69.8
ıce	≤2%
	Annual site tonnage ≤0.16 t/a (Closed system) ≤0.03 t/a open systems
of	Continuous release(d/a): 300
	Local freshwater dilution factor 10 Receiving surface water flow is 18000 m³/d. Local marine water dilution factor 100
	Not applicable.
d	% Release fraction to wastewater from process (initial release prior to RMM) 0.2
vel	% Release fraction to air from process (initial release prior to RMM) 0.01
ase	% Release fraction to soil from process (initial release prior to RMM) 1
ions	On-site wastewater treatment required.
or	Ensure all waste water is collected and treated via a waste water treatment plant. Floors should be impervious, resistant to liquids and easy to clean.

Section 2 - Exposure controls

Conditions and measures related to municipal sewage treatment plant	Size of industrial sewage treatment plant (m3/d): 2000 , Removal Efficiency (total) 94%
Conditions and measures related to external treatment of waste for disposal	No special measures are required. See section 13 for waste disposal information.
Conditions and measures related to external recovery of waste	See section 13 for waste disposal information.

Contributing scenario controlling worker exposure for 0:	
Product characteristics	Melting/Freezing Point (°C): 69.8
Concentration of substance in mixture or article	≤2%
Physical state	solid
Dust	Solid, medium dustiness
Frequency and duration of use	Exposure duration per year: 230 days Exposure duration per day: 8 h (full shift).
Human factors not influenced by risk management	Respiratory m³/d: 10
Other given operational conditions affecting workers exposure	The product should be handled at room temperature. Lubricants (Closed system)
Technical conditions and measures at process level (source) to prevent release	No special measures required.
Technical conditions and measures to control dispersion from source towards the worker	Handle only in a place with local exhaust ventilation (or other adequate ventilation).
Organisational measures to prevent/limit releases, dispersion and exposure	Ensure operatives are trained to minimise exposures.
Conditions and measures related to personal protection and hygiene	
Personal protection	Wear protective clothing. See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not available.
Exposure estimation and reference to its source - Environment: 2:	
Exposure assessment (environment):	Used EUSES model. (v2.1)
Exposure estimation	Risk characterisation ratio (PEC/PNEC): <1
Exposure estimation and reference to its source - Workers: 1:	
Exposure assessment (human):	Used ECETOC TRA model (May 2010 release).
Exposure estimation	Risk characterisation ratio DNELs <1

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set

	Use as lubricant in open and closed systems- Professional (2,6-di-tert-butyl-p-cresol)
dance to DU to evaluate whether he works inside the boundaries set	
	Not available. Not available.
	Not available. Wear protective gloves/protective clothing/eye protection/face protection. Wear respiratory protection. See Section 8 for information on appropriate personal protective equipment.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Industrial

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Distribution of substance- Industrial (Other Lubricant Base Oils, IP346<3%, H304)
List of use descriptors	**Identified use name:** Distribution of substance - Industrial **Process Category:** PROC01, PROC02, PROC03, PROC04, PROC08a, PROC08b, PROC09, PROC15 **Substance supplied to that use in form of:** Substance **Sector of end use:** SU03 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC04, ERC05, ERC06a, ERC06b, ERC06c, ERC06d, ERC07, ESVOC SpERC 1.1b.v1 **Market sector by type of chemical product:** Not applicable. **Article category related to subsequent service life:** Not applicable.
Environmental contributing scenarios	**Distribution of substance**
Health Contributing scenarios	**Distribution of substance**

Number of the ES	9.3.1b
Industry Association	Concawe 2012
Generic exposure scenario	01a
Processes and activities covered by the exposure scenario	Bulk loading (including marine vessel/barge, rail/road car and IBC loading) of substance within closed or contained systems, including incidental exposures during its sampling, storage, unloading, maintenance and associated laboratory activities.
Additional information	Industrial

Section 2 - Exposure controls

Product characteristics	Substance is complex UVCB.. Predominantly hydrophobic
Amounts used	Fraction of EU tonnage used in region 0.1 Regional use tonnage 8.5E+5 Fraction of Regional tonnage used locally 1 Maximum daily site tonnage 1.7E+4
Frequency and duration of use	Continuous release Emission Days (days/year) 100
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Release fraction to air from process (initial release prior to RMM) 1.0E-4 Release fraction to wastewater from process (initial release prior to RMM) 1.0E-7 Release fraction to soil from process (initial release prior to RMM) 0.00001
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used.
Technical on-site conditions	Risk from environmental exposure is driven by

re controls

Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.4
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0

to site — Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

Estimated substance removal from wastewater via on-site sewage treatment94.7
ge — Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7
Maximum allowable site tonnage (M_{Site}) based on release following total wastewater treatment removal1.1E+5
Assumed on-site sewage treatment plant flow2000

ent — External treatment and disposal of waste should comply with applicable local and/or national regulations.

ry — External recovery and recycling of waste should comply with applicable local and/or national regulations.

trolling worker exposure for 0: Distribution of substance

Liquid, vapour pressure < 0.5 kPa at STP

nce — Covers percentage substance in the product up to 100% (unless stated differently).

Liquid

of — Covers daily exposures up to 8 hours (unless stated differently)

ers — Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented
Aspiration hazard if swallowed.
Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract.
Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death.
This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage.
Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties.
Do not induce vomiting as there is high risk of aspiration.
IF SWALLOWED: Immediately call a POISON CENTER or physician.

Contributing scenarios - Operational conditions and risk management measures

General exposures (closed systems)
No other specific measures identified.

General exposures (open systems)
No other specific measures identified.

Process sampling
No other specific measures identified.

Laboratory activities
No other specific measures identified.

Bulk transfers closed systems
No other specific measures identified.

Section 2 - Exposure controls

Drum and small package filling
No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

Conditions and measures related to personal protection and hygiene

Personal protection	See Section 8 of the safety data sheet (general health and safety measures). See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not applicable.

Exposure estimation and reference to its source - Environment: 2: Distribution of substance

Exposure assessment (environment):	Not available.
Exposure estimation	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure estimation and reference to its source - Workers: 1: Distribution of substance

Exposure assessment (human):	Not available.
Exposure estimation	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
Health	The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion. A DNEL (derived no effect levels) cannot be derived. This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern. There are no routine anticipated exposures by ingestion related to any supported uses of the substance. The risk arising from aspiration hazard is solely related to the

Distribution of substance- Industrial (Other Lubricant Base Oils, IP346<3%, H304)

dance to DU to evaluate whether he works inside the boundaries set

communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Industrial

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Formulation & (re)packing of substances and mixtures- Industrial (Other Lubricant Base Oils, IP346<3%)
List of use descriptors	**Identified use name:** Formulation and (re)packing of substances and mixtures - Industrial **Process Category:** PROC01, PROC02, PROC03, PROC04, PROC05, PROC08a, PROC08b, PROC09, PROC14, PROC15 **Substance supplied to that use in form of:** Substance **Sector of end use:** SU10 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC02, ESVOC SpERC 2.2.v1 **Market sector by type of chemical product:** Not applicable. **Article category related to subsequent service life:** Not applicable.
Environmental contributing scenarios	**Formulation and (re)packing of substances and mixtures**
Health Contributing scenarios	**Formulation and (re)packing of substances and mixtures**
Number of the ES	9.4.1b
Industry Association	Concawe 2012
Generic exposure scenario	02
Processes and activities covered by the exposure scenario	Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tabletting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities.
Additional Information	Industrial

Section 2 - Exposure controls

Product characteristics	Substance is complex UVCB.. Predominantly hydrophobic
Amounts used	Fraction of EU tonnage used in region 0.1 Regional use tonnage 8.5E+5 Fraction of Regional tonnage used locally 1 Annual site tonnage 3.0E+4 Maximum daily site tonnage 1.0E+5
Frequency and duration of use	Continuous release Emission Days (days/year)300
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Release fraction to air from process (initial release prior to RMM)2.5E-3 Release fraction to wastewater from process (initial release prior to RMM)5.0E-6 Release fraction to soil from process (initial release prior to RMM) 0.0001
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used.

...ure controls

Treat air emission to provide a typical removal efficiency of0

Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of69.5
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0

...to ...site — Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.

...s ...ge — Not applicable as there is no release to wastewater.
Estimated substance removal from wastewater via on-site sewage treatment 94.7
Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7
Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal5.7E+5
Assumed on-site sewage treatment plant flow2000

...s ...ent — External treatment and disposal of waste should comply with applicable local and/or national regulations.

...s ...ery — External recovery and recycling of waste should comply with applicable local and/or national regulations.

...ntrolling worker exposure for 0: Formulation and (re)packing of substances and mixtures

Liquid, vapour pressure < 0.5 kPa at STP

...ance — Covers percentage substance in the product up to 100% (unless stated differently).

Liquid

...of — Covers daily exposures up to 8 hours (unless stated differently)

...kers — Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented
Aspiration hazard if swallowed.
Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract.
Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death.
This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage.
Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties.
Do not induce vomiting as there is high risk of aspiration.
IF SWALLOWED: Immediately call a POISON CENTER or physician.

Contributing scenarios - Operational conditions and risk management measures

General exposures (closed systems)
No other specific measures identified.

General exposures (open systems)
No other specific measures identified.

Batch processes at elevated temperatures
No other specific measures identified.

Use in contained batch processes
No other specific measures identified.

Section 2 - Exposure controls

Laboratory activities
No other specific measures identified.Bulk transfers Dedicated facility

No other specific measures identified.

Mixing operations (open systems)
No other specific measures identified.

Transfer from/pouring from containers Manual Non-dedicated facility
No other specific measures identified.

Drum/batch transfers Dedicated facility
No other specific measures identified.

Production of preparation or articles by tabletting, compression, extrusion or pelletisation
No other specific measures identified.

Drum and small package filling
No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

Conditions and measures related to personal protection and hygiene

Personal protection	See Section 8 of the safety data sheet (general health and safety measures). See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not applicable.

Exposure estimation and reference to its source - Environment: 2: Formulation and (re)packing of substances and mixtures

Exposure assessment (environment):	Not available.
Exposure estimation	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure estimation and reference to its source - Workers: 1: Formulation and (re)packing of substances and mixtures

Exposure assessment (human):	Not available.
Exposure estimation	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. Scaled local assessments for EU refineries have been performed

dance to DU to evaluate whether he works inside the boundaries set

The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion.
A DNEL (derived no effect levels) cannot be derived.
This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance.
However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.
Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.
There are no routine anticipated exposures by ingestion related to any supported uses of the substance. The risk arising from aspiration hazard is solely related to the physico-chemical properties of the substance. The risk can therefore be controlled by implementing risk management measures tailored to this specific risk.
For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Industrial

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Manufacturer of substance- Industrial (Other Lubricant Base Oils, IP346<3%, H304)
List of use descriptors	**Identified use name:** Manufacture of substance - Industrial **Process Category:** PROC01, PROC02, PROC03, PROC04, PROC08a, PROC08b, PROC15 **Substance supplied to that use in form of:** Substance **Sector of end use:** SU03, SU08, SU09 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC04, ESVOC SpERC 1.1.v1 **Market sector by type of chemical product:** Not applicable. **Article category related to subsequent service life:** Not applicable.
Environmental contributing scenarios	**Manufacture of substance**
Health Contributing scenarios	**Manufacture of substance**

Number of the ES	9.1.1b
Industry Association	Concawe 2012
Generic exposure scenario	01
Processes and activities covered by the exposure scenario	Manufacture of the substance or use as a process chemical or extraction agent within closed or contained systems. Includes incidental exposures during recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
Additional information	Industrial

Section 2 - Exposure controls

Product characteristics	Substance is complex UVCB.. Predominantly hydrophobic
Amounts used	Fraction of EU tonnage used in region0.1 Regional use tonnage 8.5E+5 Fraction of Regional tonnage used locally 1 Annual site tonnage 6.0E+5 Maximum daily site tonnage 2.0E+6
Frequency and duration of use	Continuous release Emission Days (days/year)300
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Release fraction to air from process (initial release prior to RMM) 1.0e-4 Release fraction to wastewater from process (initial release prior to RMM) 1.0e-5 Release fraction to soil from process (initial release prior to RMM) 0.0001
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used.

...ure controls

Treat air emission to provide a typical removal efficiency of 90

Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of84.8
If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0
Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Estimated substance removal from wastewater via on-site sewage treatment94.7
Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7
Maximum allowable site tonnage (M_{Smax}) based on release following total wastewater treatment removal5.7E+6
Assumed on-site sewage treatment plant flow 10000
During manufacturing, no waste of the substance is generated.

During manufacturing, no waste of the substance is generated.

...ntrolling worker exposure for 0: Manufacture of substance

Liquid, vapour pressure < 0.5 kPa at STP
Covers percentage substance in the product up to 100% (unless stated differently).

Liquid With potential for aerosol generation
Covers daily exposures up to 8 hours (unless stated differently)

Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented
Aspiration hazard if swallowed.
Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract.
Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death.
This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage.
Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties.
Do not induce vomiting as there is high risk of aspiration.
IF SWALLOWED: Immediately call a POISON CENTER or physician.

Contributing scenarios - Operational conditions and risk management measures

General exposures (closed systems)
No other specific measures identified.

General exposures (open systems)
No other specific measures identified.

Process sampling
No other specific measures identified.

Laboratory activities
No other specific measures identified.

Section 2 - Exposure controls

No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Bulk product storage
Store substance within a closed system.

Conditions and measures related to personal protection and hygiene

Personal protection	See Section 8 of the safety data sheet (general health and safety measures). See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not applicable.

Exposure estimation and reference to its source - Environment: 2: Manufacture of substance

Exposure assessment (environment):	Not available.
Exposure estimation	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure estimation and reference to its source - Workers: 1: Manufacture of substance

Exposure assessment (human):	Not available.
Exposure estimation	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
Health	The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion. A DNEL (derived no effect levels) cannot be derived. This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern. There are no routine anticipated exposures by ingestion related to any supported uses of the substance. The risk arising from aspiration hazard is solely related to the physico-chemical properties of the substance. The risk can therefore be controlled by

dance to DU to evaluate whether he works inside the boundaries set

If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Industrial

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Uses in Functional fluids - Industrial (Other Lubricant Base Oils, IP346<3%, H304)
List of use descriptors	**Identified use name:** Functional Fluids - Industrial **Process Category:** PROC01, PROC03, PROC08a, PROC08b, PROC02, PROC04, PROC09 **Substance supplied to that use in form of:** Substance **Sector of end use:** SU03 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC07, **Market sector by type of chemical product:** Not applicable. **Article category related to subsequent service life:** Not applicable.
Environmental contributing scenarios	**Functional Fluids**
Health Contributing scenarios	**Functional Fluids**

Number of the ES	9.37.1b
Industry Association	Concawe 2012
Generic exposure scenario	13a
Processes and activities covered by the exposure scenario	Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in industrial equipment including maintenance and related material transfers.
Additional information	Industrial

Section 2 - Exposure controls

Product characteristics	Substance is complex UVCB. Predominantly hydrophobic
Amounts used	Fraction of EU tonnage used in region0.1 Regional use tonnage1.2E+3 Fraction of Regional tonnage used locally1 Annual site tonnage1.0E+1 Maximum daily site tonnage5.0E+2
Frequency and duration of use	Continuous release Emission Days (days/year)20
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Release fraction to air from process (initial release prior to RMM)5.0E-4 Release fraction to wastewater from process (initial release prior to RMM)1.0E-6 Release fraction to soil from process (initial release prior to RMM)0.001
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used.
Technical on-site conditions	Risk from environmental exposure is driven by freshwater and

...sure controls

	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.4 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of0
...s to ...m site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
...es ...vage	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal3.3E+3 Assumed on-site sewage treatment plant flow2000
...es ...ment	External treatment and disposal of waste should comply with applicable local and/or national regulations.
...es ...very	External recovery and recycling of waste should comply with applicable local and/or national regulations.

...ontrolling worker exposure for 0: Functional Fluids

	Liquid, vapour pressure < 0.5 kPa at STP
...tance	Covers percentage substance in the product up to 100% (unless stated differently).
	Liquid With potential for aerosol generation
...n of	Covers daily exposures up to 8 hours (unless stated differently)
...rkers	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician.

Contributing scenarios - Operational conditions and risk management measures

Bulk transfers - Closed system
No other specific measures identified.

Drum/batch transfers - Dedicated facility
No other specific measures identified.

Filling of articles/equipment - closed systems
No other specific measures identified.

Filling/preparation of equipment from drums or containers - Non-dedicated facility
No other specific measures identified.

General exposures (closed systems)
No other specific measures identified.

Section 2 - Exposure controls

	Remanufacture of reject articles No other specific measures identified. Equipment cleaning and maintenance Drain down system prior to equipment break-in or maintenance. Storage Store substance within a closed system.
Conditions and measures related to personal protection and hygiene	
Personal protection	See Section 8 of the safety data sheet (general health and safety measures). See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not applicable.

Exposure estimation and reference to its source - Environment: 2: Functional Fluids

Exposure assessment (environment):	Not available.
Exposure estimation	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure estimation and reference to its source - Workers: 1: Functional Fluids

Exposure assessment (human):	Not available.
Exposure estimation	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
Health	The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion. A DNEL (derived no effect levels) cannot be derived. This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern. There are no routine anticipated exposures by ingestion related to any supported

dance to DU to evaluate whether he works inside the boundaries set

For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

Nytro 10 XN

Annex to the extended Safety Data Sheet (eSDS)

NYNAS

Professional

Identification of the substance or mixture

Product definition	Mixture
Product name	Nytro 10 XN

Section 1 - Title

Short title of the exposure scenario	Uses in Functional fluids - Professional (Other Lubricant Base Oils, IP346<3%, H304)
List of use descriptors	**Identified use name:** Functional Fluids - Professional **Process Category:** PROC01, PROC02, PROC03, PROC08a, PROC09, PROC20 **Substance supplied to that use in form of:** Substance **Sector of end use:** SU22 **Subsequent service life relevant for that use:** No. **Environmental Release Category:** ERC09a, ERC09b, ESVOC SpERC 9.13b.v1 **Market sector by type of chemical product:** Not applicable. **Article category related to subsequent service life:** Not applicable.
Environmental contributing scenarios	**Functional Fluids**
Health Contributing scenarios	**Functional Fluids**

Number of the ES	9.38.1b
Industry Association	Concawe 2012
Generic exposure scenario	13b
Processes and activities covered by the exposure scenario	Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in professional equipment including maintenance and related material transfers.
Additional information	Professional

Section 2 - Exposure controls

Product characteristics	Substance is complex UVCB. Predominantly hydrophobic
Amounts used	Fraction of EU tonnage used in region0.1 Regional use tonnage1.2E+3 Fraction of Regional tonnage used locally1 Annual site tonnage6.0E-1 Maximum daily site tonnage1.6E+0
Frequency and duration of use	Continuous release Emission Days (days/year)365
Environment factors not influenced by risk management	Local freshwater dilution factor 10 Local marine water dilution factor 100
Other given operational conditions affecting environmental exposure	Release fraction to air from process (initial release prior to RMM)0.05 Release fraction to wastewater from process (initial release prior to RMM)0.025 Release fraction to soil from process (initial release prior to RMM)0.025
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used.
Technical on-site conditions and measures to reduce or	Risk from environmental exposure is driven by freshwater sediment. If discharging to domestic sewage treatment plant, no on-site wastewater

sure controls

	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.9 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of0
s to n site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
es vage	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal1.1E+1 Assumed on-site sewage treatment plant flow2000
es ment	External treatment and disposal of waste should comply with applicable local and/or national regulations.
es very	External recovery and recycling of waste should comply with applicable local and/or national regulations.

ontrolling worker exposure for 0: Functional Fluids

	Liquid, vapour pressure < 0.5 kPa at STP
tance	Covers percentage substance in the product up to 100% (unless stated differently).
	Liquid With potential for aerosol generation
n of	Covers daily exposures up to 8 hours (unless stated differently)
rkers	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician.

Contributing scenarios - Operational conditions and risk management measures

Bulk transfers - Closed system
No other specific measures identified.

Drum/batch transfers - Dedicated facility
No other specific measures identified.

Filling of articles/equipment - closed systems
No other specific measures identified.

Filling/preparation of equipment from drums or containers - Non-dedicated facility
No other specific measures identified.

General exposures (closed systems)
No other specific measures identified.

Section 2 - Exposure controls

Remanufacture of reject articles
No other specific measures identified.

Equipment cleaning and maintenance
Drain down system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

Conditions and measures related to personal protection and hygiene

Personal protection	See Section 8 of the safety data sheet (general health and safety measures). See Section 8 of the safety data sheet (personal protective equipment).

Section 3 - Exposure estimation and reference to its source

Website:	Not applicable.

Exposure estimation and reference to its source - Environment: 2: Functional Fluids

Exposure assessment (environment):	Not available.
Exposure estimation	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Exposure estimation and reference to its source - Workers: 1: Functional Fluids

Exposure assessment (human):	Not available.
Exposure estimation	The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
Health	The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion. A DNEL (derived no effect levels) cannot be derived. This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern. There are no routine anticipated exposures by ingestion related to any supported

dance to DU to evaluate whether he works inside the boundaries set

For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

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fication of the substance/mixture and of the company/undertaking

Nytro Libra
Insulating oil
Liquid.
Oils

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e used in applications other than those on 1, without first seeking the advice of the	-

of the safety data sheet

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24 hour service

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition: Mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]
Asp. Tox. 1, H304

The product is classified as hazardous according to Regulation (EC) 1272/2008 as amended.
See Section 16 for the full text of the H statements declared above.
See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Hazard pictograms

Signal word: Danger

Hazard statements: H304 - May be fatal if swallowed and enters airways.

Precautionary statements

Prevention: Not applicable.

Response: P301 + P310 + P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.

Storage: P405 - Store locked up.

Disposal: P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles: Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII: Not applicable.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII: Not applicable.

SECTION 3: Composition/information on ingredients

3.2 Mixtures: Mixture

Product/ingredient name	Identifiers	%	Classification Regulation (EC) No. 1272/2008 [CLP]	Type
Distillate (petroleum), hydrotreated light naphthenic	REACH #: 01-2119480375-34 EC: 265-156-6 CAS: 64742-53-6 Index: 649-466-00-2	50 - 70	Asp. Tox. 1, H304	[1]
Distillate (petroleum),	REACH #:	0 - 50	Asp. Tox. 1, H304	[1]

mposition/information on ingredients

CAS: 64742-55-8 REACH #: 01-2119484627-25 EC: 265-157-1 CAS: 64742-54-7 Index: 649-467-00-8 REACH #: 01-2119474878-16 EC: 276-737-9 CAS: 72623-86-0 Index: 649-482-00-X REACH #: 01-2119483621-38 EC: 265-097-6 CAS: 64741-96-4 Index: 649-457-00-3 REACH #: 01-2119480374-36 EC: 265-098-1 CAS: 64741-97-5 Index: 649-458-00-9	0 - 50 0 - 50 0 - 5 0 - 5	Not classified. Asp. Tox. 1, H304 Not classified. Asp. Tox. 1, H304 See Section 16 for the full text of the H statements declared above.	- [1] - [1]

the base oil(s) in this product. Nota L - The classification as a carcinogen need not apply if it ubstance contains less than 3 % DMSO extract as measured by IP 346.

ngredients present which, within the current knowledge of the supplier and in the e, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been posure limit and hence require reporting in this section.

vith a health or environmental hazard
kplace exposure limit
criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
nt concern

aid measures

measures

Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If irritation, blurred vision or swelling occurs and persists, obtain medical advice from a specialist.

If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. If casualty is unconscious and: If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if adverse health effects persist or are severe. Maintain an open airway.

Wash with soap and water. Remove contaminated clothing and shoes. Handle with care and dispose of in a safe manner. Seek medical attention if skin irritation, swelling or redness develops and persists.

Accidental high pressure injection

SECTION 4: First aid measures

Ingestion

Always assume that aspiration has occurred. Do not induce vomiting. Can enter lungs and cause damage. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Seek professional medical attention or send the casualty to a hospital. Do not wait for symptoms to develop.

Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Protection of first-aiders

No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact

Eye contact may cause redness and transient pain.

Inhalation

Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.

Skin contact

No known significant effects or critical hazards.

Ingestion

May be fatal if swallowed and enters airways.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician

No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.

Specific treatments

Always assume that aspiration has occurred.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media

Do not use direct water jets on the burning product; they could cause splattering and spread the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

5.2 Special hazards arising from the substance or mixture

Hazards from the substance or mixture

In a fire or if heated, a pressure increase will occur and the container may burst. This substance will float and can be reignited on surface water.

Hazardous thermal decomposition products

Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

5.3 Advice for firefighters

Special precautions for fire-fighters

Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable

lental release measures

protective equipment and emergency procedures

Avoid breathing vapour or mist. Keep non-involved personnel away from the area of spillage. Alert emergency personnel. Except in case of small spillages, the feasibility of any actions should always be assessed and advised, if possible, by a trained, competent person in charge of managing the emergency. Stop leak if safe to do so. Avoid direct contact with the product. Stay upwind/keep distance from source. In case of large spillages, alert occupants in downwind areas.

Eliminate all ignition sources if safe to do so. Spillages of limited amounts of product, especially in the open air when vapours will be usually quickly dispersed, are dynamic situations, which will presumably limit the exposure to dangerous concentrations.

Note : recommended measures are based on the most likely spillage scenarios for this material; however, local conditions (wind, air temperature, wave/current direction and speed) may significantly influence the choice of appropriate actions. For this reason, local experts should be consulted when necessary. Local regulations may also prescribe or limit actions to be taken.

lers Small spillages: normal antistatic working clothes are usually adequate.

Large spillages: full body suit of chemically resistant and thermal resistant material should be used. Work gloves providing adequate chemical resistance, specifically to aromatic hydrocarbons. Note : gloves made of PVA are not water-resistant, and are not suitable for emergency use. Safety helmet, antistatic non-skid safety shoes or boots. Goggles and /or face shield, if splashes or contact with eyes is possible or anticipated.

Respiratory protection : A half or full-face respirator with filter(s) for organic vapours (and when applicable for H2S) a Self Contained Breathing Apparatus (SCBA) can be used according to the extent of spill and predictable amount of exposure. If the situation cannot be completely assessed, or if an oxygen deficiency is possible, only SCBA's should be used.

utions Prevent product from entering sewers, rivers or other bodies of water. If necessary dike the product with dry earth, sand or similar non-combustible materials. In case of soil contamination, remove contaminated soil and treat in accordance with local regulations.

In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents.

If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities.

al for containment and cleaning up

Stop leak if without risk. Absorb spilled product with suitable non-combustible materials.

Large spillages may be cautiously covered with foam, if available, to limit vapour cloud formation. Do not use water jet. When inside buildings or confined spaces, ensure adequate ventilation. Transfer collected product and other contaminated materials to suitable containers for recovery or safe disposal. Note: see Section 1 for emergency contact information and Section 13 for waste disposal. See Section 8 for information on appropriate personal protective equipment.

SECTION 7: Handling and storage

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

General information	Obtain special instructions before use. Hazard of slipping on spilt product. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Use and store only outdoors or in a well-ventilated area. Avoid release to the environment.
7.1 Precautions for safe handling	
Protective measures	Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Avoid contact with eyes, skin and clothing. Prevent the risk of slipping. Take precautionary measures against static discharge. Avoid splash filling of bulk volumes when handling hot liquid product. Nota : See Section 8 for information on appropriate personal protective equipment. See section 13 for waste disposal information.
Advice on general occupational hygiene	Ensure that proper housekeeping measures are in place. Contaminated materials should not be allowed to accumulate in the workplaces and should never be kept inside the pockets. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash hands thoroughly after handling. Change contaminated clothes at the end of working shift. See also Section 8 for additional information on hygiene measures.
7.2 Conditions for safe storage, including any incompatibilities	Storage area layout, tank design, equipment and operating procedures must comply with the relevant European, national or local legislation. Storage area layout, tank design, equipment and operating procedures must comply with the relevant regional, national or local legislation. Storage installations should be designed with adequate bunds in case of leaks or spills. Cleaning, inspection and maintenance of internal structure of storage tanks must be done only by properly equipped and qualified personnel as defined by national, local or company regulations. Store separately from oxidising agents. Recommended materials for containers, or container linings use mild steel, stainless steel. Not suitable : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Compatibility should be checked with the manufacturer. Keep only in the original container or in a suitable container for this kind of product. Keep container tightly closed and sealed until ready for use. Do not store in unlabelled containers. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Empty containers may contain harmful, flammable/combustible or explosive residue or vapours. Do not cut, grind, drill, weld, reuse or dispose of containers unless adequate precautions are taken against these hazards. Store locked up. Protect from sunlight.
7.3 Specific end use(s)	
Recommendations	Not available.
Industrial sector specific solutions	Not available.

posure controls/personal protection

es in Section 1 should be consulted for any available use-specific information provided in the

e limits

name	Exposure limit values
	[Air contaminant] **Rozporzadzenie Ministra Pracy i Polityki Spolecznej (Dz.U. 2014 poz. 817) (Poland, 6/2014).** TWA: 5 mg/m³ 8 hours. Form: Inhalable fraction

ring If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to appropriate monitoring standards. Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

name	Type	Exposure	Value	Population	Effects
hydrotreated	DNEL	Long term Inhalation	5,4 mg/m³	Workers	Local
hydrotreated	DNEL	Long term Inhalation	5,4	Workers	Local
, solvent-lc	DNEL	Long term Inhalation	5,4 mg/m³	Workers	Local

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

Mechanical ventilation and local exhaust will reduce exposure via the air. Use oil resistant material in construction of handling equipment. Store under recommended conditions and if heated, temperature control equipment should be used to avoid overheating.

sures

Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Wash contaminated clothing before reuse.

Recommended: Safety glasses with side shields.

4 - 8 hours (breakthrough time): nitrile rubber

Wear protective clothing if there is a risk of skin contact. Change contaminated clothes at the end of working shift.

Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary.

Emissions from ventilation or work process equipment should be checked to

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	
Physical state	Liquid.
Colour	Light yellow
Odour	Odourless/Light petroleum.
Odour threshold	Not available.
pH	Not applicable.
Melting point/freezing point	-51°C
Initial boiling point and boiling range	>250°C
Flash point	Closed cup: >140°C [Pensky-Martens.]
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	Not available.
Vapour pressure	160 Pa @ 100 °C
Density	0.88 g/cm³ [15°C]
Solubility(ies)	Insoluble in water.
Partition coefficient: n-octanol/water	Not available.
Auto-ignition temperature	>270°C
Decomposition temperature	>280°C
Viscosity	Kinematic (40°C): 0.096 cm²/s (9.6 cSt)
Explosive properties	Not available.
Oxidising properties	Not available.
DMSO extractable compounds for base oil substance(s) according to IP346	< 3%

SECTION 10: Stability and reactivity

10.1 Reactivity	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	Stable under normal conditions.
10.3 Possibility of hazardous reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	Oxidising agent.
10.5 Incompatible materials	Keep away from extreme heat and oxidizing agents.
10.6 Hazardous decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

icological information

Result	Species	Dose	Exposure	Remarks
LC50 Inhalation Dusts and mists	Rat - Male, Female	>5.53 mg/l	4 hours	EMBSI 1988a (similar material)
LD50 Dermal	Rabbit	>5000 mg/kg	-	API 1982 (similar material)
LD50 Oral	Rat	>5000 mg/kg	-	API 1986a (similar material)
LC50 Inhalation Dusts and mists	Rat - Male, Female	>5.53 mg/l	4 hours	EMBSI 1988a (similar material)
LD50 Dermal	Rabbit	>5000 mg/kg	-	API 1982 (similar material)
LD50 Oral	Rat	>5000 mg/kg	-	API 1986a (similar material)
LC50 Inhalation Dusts and mists	Rat - Male, Female	>5.53 mg/l	4 hours	EMBSI 1988a (similar material)
LD50 Dermal	Rabbit	>5000 mg/kg	-	API 1982 (similar material)
LD50 Oral	Rat	>5000 mg/kg	-	API 1986a (similar material)
LC50 Inhalation Dusts and mists	Rat - Male, Female	>5.53 mg/l	4 hours	EMBSI 1988a (similar material)
LD50 Dermal	Rabbit	>5000 mg/kg	-	API 1982 (similar material)
LD50 Oral	Rat	>5000 mg/kg	-	API 1986a (similar material)

No known significant effects or critical hazards.

Result	Species	Score	Observation	Remarks
Skin - Non-irritant to skin.	Rabbit	0 to 0.8	24 to 72 hours	UBTL 1984e (similar material)
Eyes - Non-irritating to the eyes.	Rabbit	0.17 to 0.33	24 to 72 hours	UBTL 1984i (similar material)
Eyes - Non-irritating to the eyes.	Rabbit	0.17 to 0.33	24 to 72 hours	UBTL 1984l (similar material)
Skin - Non-irritant to skin.	Rabbit	0 to 0.8	24 to 72 hours	UBTL 1984e (similar material)
Eyes - Non-irritating to the eyes.	Rabbit	0.17 to 0.33	24 to 72 hours	UBTL 1984l (similar material)
Skin - Non-irritant to skin.	Rabbit	0 to 0.8	24 to 72 hours	UBTL 1984e (similar material)
Eyes - Non-irritating to the eyes.	Rabbit	0.17 to 0.33	24 to 72 hours	UBTL 1984i (similar material)

No known significant effects or critical hazards.
No known significant effects or critical hazards.

SECTION 11: Toxicological information

Product/ingredient name	Route of exposure	Species	Result	Remarks
Distillate (petroleum), hydrotreated light naphthenic	skin	Guinea pig	Not sensitizing	UBTL 1984j,k,l (similar material)
Lubricating oils (petroleum), C15-30, hydrotreated neutral oil-based	skin	Guinea pig	Not sensitizing	UBTL 1984j,k,l (similar material)
Distillate (petroleum), hydrotreated light paraffinic	skin	Guinea pig	Not sensitizing	UBTL 1984j,k,l (similar material)
Distillates (petroleum), solvent-refined light naphthenic	skin	Guinea pig	Not sensitizing	UBTL 1984j,k,l (similar material)

Skin — No known significant effects or critical hazards.
Respiratory — No known significant effects or critical hazards.

Mutagenicity

Product/ingredient name	Test	Experiment	Result	Remarks
Distillate (petroleum), hydrotreated light naphthenic	OECD 473 473 In vitro Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal Metabolic activation: with and without	Negative	-
Lubricating oils (petroleum), C15-30, hydrotreated neutral oil-based	OECD 473 473 In vitro Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal Metabolic activation: with and without	Negative	-
Distillate (petroleum), hydrotreated light paraffinic	OECD 473 473 In vitro Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal Metabolic activation: with and witout	Negative	-
Distillates (petroleum), solvent-refined light naphthenic	OECD 473 473 In vitro Mammalian Chromosomal Aberration Test	Experiment: In vitro Subject: Mammalian-Animal Metabolic activation: With and without	Negative	Reference report 1987 (similar material)

oxicological information

	Result	Species	Dose	Exposure	Remarks
	Negative - Dermal	Mouse - Female	0.22 to 0.25 ml	78 weeks; Various	Doak, 1983, McKee, 1989 (similar material)
	Negative - Dermal	Mouse - Female	0.22 to 0.25 ml	78 weeks; Various	Doak, 1983, McKee, 1989 (similar material)
	Negative - Dermal	Mouse - Female	0.22 to 0.25 ml	78 weeks; Various	Doak, 1983, McKee, 1989 (similar material)
	Negative - Dermal	Mouse - Female	0.22 to 0.25 ml	78 weeks; Various	Doak 1983, McKee 1989 (similar material)

The base oil(s) in this product is based on an severely hydrotreated distillate. The product should not be regarded as a carcinogen.

No known significant effects or critical hazards.

	Result	Species	Dose	Exposure	Remarks
	Negative - Dermal	Rat	0 to 2000 mg/kg mg/kg/day	-	(similar material)
	Negative - Dermal	Rat	0 to 2000 mg/kg mg/kg/day	-	-
	Negative - Dermal	Rat	0 to 2000 mg/kg mg/kg/day	-	-
	Negative - Dermal	Rat	0 to 2000 mg/kg mg/kg/day	-	1987 (similar material)

No known significant effects or critical hazards.

me	Result
drotreated light naphthenic m), C15-30, hydrotreated neutral oil-	ASPIRATION HAZARD - Category 1 ASPIRATION HAZARD - Category 1
drotreated light paraffinic olvent-refined light naphthenic	ASPIRATION HAZARD - Category 1 ASPIRATION HAZARD - Category 1

Not available.

cts

Eye contact may cause redness and transient pain.

Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.

No known significant effects or critical hazards.

May be fatal if swallowed and enters airways.

fects

SECTION 11: Toxicological information

Mutagenicity	No known significant effects or critical hazards.
Teratogenicity	No known significant effects or critical hazards.
Developmental effects	No known significant effects or critical hazards.
Fertility effects	No known significant effects or critical hazards.
Other information	Not available.

Specific hazard

SECTION 12: Ecological information

12.1 Toxicity

Product/ingredient name	Result	Species	Exposure
Distillate (petroleum), hydrotreated light naphthenic	Acute LL50 >10000 mg/l	Aquatic invertebrates.	96 hours
Lubricating oils (petroleum), C15-30, hydrotreated neutral oil-based	Acute LL50 >100 mg/l Acute NOEL >100 mg/l Chronic NOEL 10 mg/l Acute LL50 >10000 mg/l	Fish Algae Aquatic invertebrates. Aquatic invertebrates.	96 hours 72 hours 21 days 96 hours
Distillates (petroleum), hydrotreated light paraffinic	Acute LL50 >100 mg/l Acute NOEL >100 mg/l Chronic NOEL 10 mg/l Acute IC50 >100 mg/l	Fish Algae Aquatic invertebrates. Algae	96 hours 72 hours 21 days 48 hours
Distillates (petroleum), solvent-refined light naphthenic	Acute LC50 >100 mg/l Acute LL50 >10000 mg/l Acute LL50 >100 mg/l Acute NOEL >100 mg/l Chronic NOEL 10 mg/l Acute LL50 >10000 mg/l	Fish Aquatic invertebrates. Fish Algae Aquatic invertebrates. Aquatic invertebrates.	96 hours 96 hours 96 hours 72 hours 21 days 96 hours
	Acute LL50 >100 mg/l Acute NOEL >100 mg/l Chronic NOEL 10 mg/l	Fish Algae Aquatic invertebrates.	96 hours 72 hours 21 days

Conclusion/Summary: No known significant effects or critical hazards.

12.2 Persistence and degradability

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Distillate (petroleum), hydrotreated light naphthenic	-	-	Inherent
Lubricating oils (petroleum), C15-30, hydrotreated neutral oil-based	-	-	Inherent
Distillates (petroleum), hydrotreated light paraffinic	-	-	Inherent
Distillates (petroleum), solvent-refined light naphthenic	-	-	Inherent

Conclusion/Summary: Inherently biodegradable.

12.3 Bioaccumulative potential

logical information

me	LogP$_{ow}$	BCF	Potential
henic	2 to 6	<500	low
um),	2 to 6	<500	low
	2 to 6	<500	low
inic	2 to 6	<500	low

The product has a potential to bioaccumulate.

High mobility in soil predicted, based on log Kow > 3.0.

vPvB assessment

Not applicable.

Not applicable.

cts Insoluble in water. Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

sposal considerations

ection contains generic advice and guidance. The list of Identified Uses in Section 1 should be ble use-specific information provided in the Exposure Scenario(s).

ethods

Where possible (e.g. in the absence of relevant contamination), recycling of used substance is feasible and recommended. This substance can be burned or incinerated, subject to national/local authorizations, relevant contamination limits, safety regulations and air quality legislation. Contaminated or waste substance (not directly recyclable): Disposal can be carried out directly, or by delivery to qualified waste handlers. National legislation may identify a specific organization, and/or prescribe composition limits and methods for recovery or disposal.

Yes.

logue (EWC)

	Waste designation
	mineral-based non-chlorinated insulating and heat transmission oils

The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

ansport information

t regulations

SECTION 14: Transport information

	ADR/RID	ADN	IMO/IMDG Classification	ICAO/IATA Classification
14.1 UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
14.2 UN proper shipping name	-	-	-	-
14.3 Transport hazard class(es)	-	-	-	-
14.4 Packing group	-	-	-	-
14.5 Environmental hazards	No.	No.	No.	No.
Additional information	-	-	-	-

14.6 Special precautions for user — **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

14.7 Transport in bulk according to Annex I of MARPOL 73/78 and the IBC Code — Oils

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Annex XIV

None of the components are listed.

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles — Not applicable.

Other EU regulations

Seveso Directive

This product is not controlled under the Seveso Directive.

National regulations

Product/ingredient name	List name	Name on list	Classification	Notes
Distillates (petroleum), hydrotreated light paraffinic	Poland Carcinogen, Mutagen chemicals	Destylaty lekkie parafinowe, obrabiane wodorem (ropa	Carc.. cat.2	-

egulatory information

All components are listed or exempted.
All components are listed or exempted.
All components are listed or exempted.
All components are listed or exempted.
Not determined.
All components are listed or exempted.
All components are listed or exempted.
All components are listed or exempted.
All components are listed or exempted.
All components are listed or exempted.

Complete.

ner information

Not available.

n that has changed from previously issued version.

ADN = European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterway
ADR = The European Agreement concerning the International Carriage of Dangerous Goods by Road
ATE = Acute Toxicity Estimate
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
CMR = Carcinogen, Mutagen or Reproductive toxicant
CSA = Chemical Safety Assessment
CO_2 = carbon dioxide
DNEL = Derived No Effect Level
EC50 = Half maximal effective concentration
EUH statement = CLP-specific Hazard statement
IATA = International Air Transport Association
IC50 = Half maximal inhibitory concentration
IMDG = International Maritime Dangerous Goods
LC50 = Median lethal concentration
LD50 = Median lethal dose
PNEC = Predicted No Effect Concentration
PBT = Persistent, Bioaccumulative and Toxic
RID = The Regulations concerning the International Carriage of Dangerous Goods by Rail
REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006]
SCBA = Self-Contained Breathing Apparatus
SVHC = Substances of Very High Concern

the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

ssification	Justification
	Calculation method

H304 May be fatal if swallowed and enters airways.

Asp. Tox. 1, H304 ASPIRATION HAZARD - Category 1

SECTION 16: Other information

Date of previous issue	No previous validation
Version	1

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

bstance or mixture

Mixture

Nytro Libra

re Distribution of substance- Industrial (Other Lubricant Base Oils, IP346<3%, H304)

Identified use name: Distribution of substance - Industrial
Process Category: PROC01, PROC02, PROC03, PROC04, PROC08a, PROC08b, PROC09, PROC15
Substance supplied to that use in form of: Substance
Sector of end use: SU03
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC04, ERC05, ERC06a, ERC06b, ERC06c, ERC06d, ERC07, ESVOC SpERC 1.1b.v1
Market sector by type of chemical product: Not applicable.
Article category related to subsequent service life: Not applicable.

ing **Distribution of substance**

narios **Distribution of substance**

	9.3.1b
	Concawe 2012
ario	01a
s re	Bulk loading (including marine vessel/barge, rail/road car and IBC loading) of substance within closed or contained systems, including incidental exposures during its sampling, storage, unloading, maintenance and associated laboratory activities.
	Industrial

sure controls

Substance is complex UVCB.. Predominantly hydrophobic
Fraction of EU tonnage used in region 0.1
Regional use tonnage 8.5E+5
Fraction of Regional tonnage used locally 1
Maximum daily site tonnage 1.7E+4

n of Continuous release
Emission Days (days/year) 100

t Local freshwater dilution factor 10
Local marine water dilution factor 100

l Release fraction to air from process (initial release prior to RMM) 1.0E-4
Release fraction to wastewater from process (initial release prior to RMM) 1.0E-7
re Release fraction to soil from process (initial release prior to RMM) 0.00001

nd evel ease Common practices vary across sites thus conservative process release estimates used.

ditions Risk from environmental exposure is driven by freshwater sediment.
If discharging to domestic sewage treatment plant, no onsite wastewater treatment

Section 2 - Exposure controls

Risk management measures - Water	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.4 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0
Organisational measures to prevent/limit release from site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Conditions and measures related to municipal sewage treatment plant	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{safe}) based on release following total wastewater treatment removal1.1E+5 Assumed on-site sewage treatment plant flow2000
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.

Contributing scenario controlling worker exposure for 0: Distribution of substance

Product characteristics	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in mixture or article	Covers percentage substance in the product up to 100% (unless stated differently).
Physical state	Liquid
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently)
Other given operational conditions affecting workers exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician. Contributing scenarios - Operational conditions and risk management measures General exposures (closed systems) No other specific measures identified. General exposures (open systems) No other specific measures identified. Process sampling No other specific measures identified. Laboratory activities No other specific measures identified. Bulk transfers closed systems No other specific measures identified.

osure controls

Drum and small package filling
No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

ures related to personal protection and hygiene

See Section 8 of the safety data sheet (general health and safety measures).
See Section 8 of the safety data sheet (personal protective equipment).

osure estimation and reference to its source

Not applicable.

d reference to its source - Environment: 2: Distribution of substance

t Not available.

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

d reference to its source - Workers: 1: Distribution of substance

Not available.

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

nce to DU to evaluate whether he works inside the boundaries set

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion.
A DNEL (derived no effect levels) cannot be derived.
This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance.
However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.
Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.
There are no routine anticipated exposures by ingestion related to any supported

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Industrial

ubstance or mixture

Mixture

Nytro Libra

re Formulation & (re)packing of substances and mixtures- Industrial (Other Lubricant Base Oils, IP346<3%)

Identified use name: Formulation and (re)packing of substances and mixtures - Industrial
Process Category: PROC01, PROC02, PROC03, PROC04, PROC05, PROC08a, PROC08b, PROC09, PROC14, PROC15
Substance supplied to that use in form of: Substance
Sector of end use: SU10
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC02, ESVOC SpERC 2.2.v1
Market sector by type of chemical product: Not applicable.
Article category related to subsequent service life: Not applicable.

ting **Formulation and (re)packing of substances and mixtures**

enarios **Formulation and (re)packing of substances and mixtures**

9.4.1b
Concawe
2012

ario 02

s
re Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tabletting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities.

Industrial

sure controls

Substance is complex UVCB.. Predominantly hydrophobic
Fraction of EU tonnage used in region 0.1
Regional use tonnage 8.5E+5
Fraction of Regional tonnage used locally 1
Annual site tonnage 3.0E+4
Maximum daily site tonnage 1.0E+5

n of Continuous release
Emission Days (days/year)300

ot Local freshwater dilution factor 10
Local marine water dilution factor 100

l Release fraction to air from process (initial release prior to RMM)2.5E-3
Release fraction to wastewater from process (initial release prior to RMM)5.0E-6

re Release fraction to soil from process (initial release prior to RMM) 0.0001

nd
evel
ease Common practices vary across sites thus conservative process release estimates used.

Section 2 - Exposure controls

Risk management measures - Air	Treat air emission to provide a typical removal efficiency of0
Risk management measures - Water	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of69.5 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0
Organisational measures to prevent/limit release from site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Conditions and measures related to municipal sewage treatment plant	Not applicable as there is no release to wastewater. Estimated substance removal from wastewater via on-site sewage treatment 94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Site}) based on release following total wastewater treatment removal5.7E+5 Assumed on-site sewage treatment plant flow2000
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.

Contributing scenario controlling worker exposure for 0: Formulation and (re)packing of substances and mixtures

Product characteristics	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in mixture or article	Covers percentage substance in the product up to 100% (unless stated differently).
Physical state	Liquid
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently)
Other given operational conditions affecting workers exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician. Contributing scenarios - Operational conditions and risk management measures General exposures (closed systems) No other specific measures identified. General exposures (open systems) No other specific measures identified. Batch processes at elevated temperatures No other specific measures identified. Use in contained batch processes No other specific measures identified.

posure controls

Laboratory activities
No other specific measures identified.Bulk transfers Dedicated facility

No other specific measures identified.

Mixing operations (open systems)
No other specific measures identified.

Transfer from/pouring from containers Manual Non-dedicated facility
No other specific measures identified.

Drum/batch transfers Dedicated facility
No other specific measures identified.

Production of preparation or articles by tabletting, compression, extrusion or pelletisation
No other specific measures identified.

Drum and small package filling
No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

es related to personal protection and hygiene

See Section 8 of the safety data sheet (general health and safety measures).
See Section 8 of the safety data sheet (personal protective equipment).

sure estimation and reference to its source

Not applicable.

reference to its source - Environment: 2: Formulation and (re)packing of substances and

Not available.

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

reference to its source - Workers: 1: Formulation and (re)packing of substances and mixtures

Not available.

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

ce to DU to evaluate whether he works inside the boundaries set

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. Scaled local

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Health	The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion. A DNEL (derived no effect levels) cannot be derived. This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern. There are no routine anticipated exposures by ingestion related to any supported uses of the substance. The risk arising from aspiration hazard is solely related to the physico-chemical properties of the substance. The risk can therefore be controlled by implementing risk management measures tailored to this specific risk. For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Industrial

ubstance or mixture

Mixture

Nytro Libra

re Manufacturer of substance- Industrial (Other Lubricant Base Oils, IP346<3%, H304)

Identified use name: Manufacture of substance - Industrial
Process Category: PROC01, PROC02, PROC03, PROC04, PROC08a, PROC08b, PROC15
Substance supplied to that use in form of: Substance
Sector of end use: SU03, SU08, SU09
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC04, ESVOC SpERC 1.1.v1
Market sector by type of chemical product: Not applicable.
Article category related to subsequent service life: Not applicable.

ing **Manufacture of substance**

narios **Manufacture of substance**

	9.1.1b
	Concawe 2012
ario	01
s e	Manufacture of the substance or use as a process chemical or extraction agent within closed or contained systems. Includes incidental exposures during recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
	Industrial

sure controls

Substance is complex UVCB.. Predominantly hydrophobic
Fraction of EU tonnage used in region0.1
Regional use tonnage 8.5E+5
Fraction of Regional tonnage used locally 1
Annual site tonnage 6.0E+5
Maximum daily site tonnage 2.0E+6

of Continuous release
Emission Days (days/year)300

Local freshwater dilution factor 10
Local marine water dilution factor 100

Release fraction to air from process (initial release prior to RMM) 1.0e-4
Release fraction to wastewater from process (initial release prior to RMM) 1.0e-5
e Release fraction to soil from process (initial release prior to RMM) 0.0001

d vel ase Common practices vary across sites thus conservative process release estimates used.

tions Risk from environmental exposure is driven by freshwater sediment.

Section 2 - Exposure controls

Risk management measures - Air	Treat air emission to provide a typical removal efficiency of 90
Risk management measures - Water	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of84.8 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of 0
Organisational measures to prevent/limit release from site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Conditions and measures related to municipal sewage treatment plant	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal5.7E+6 Assumed on-site sewage treatment plant flow 10000
Conditions and measures related to external treatment of waste for disposal	During manufacturing, no waste of the substance is generated.
Conditions and measures related to external recovery of waste	During manufacturing, no waste of the substance is generated.

Contributing scenario controlling worker exposure for 0: Manufacture of substance	
Product characteristics	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in mixture or article	Covers percentage substance in the product up to 100% (unless stated differently).
Physical state	Liquid With potential for aerosol generation
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently)
Other given operational conditions affecting workers exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician. Contributing scenarios - Operational conditions and risk management measures General exposures (closed systems) No other specific measures identified. General exposures (open systems) No other specific measures identified. Process sampling No other specific measures identified. Laboratory activities No other specific measures identified.

osure controls

No other specific measures identified.

Equipment cleaning and maintenance
Drain down and flush system prior to equipment break-in or maintenance.

Bulk product storage
Store substance within a closed system.

res related to personal protection and hygiene

- See Section 8 of the safety data sheet (general health and safety measures).
See Section 8 of the safety data sheet (personal protective equipment).

sure estimation and reference to its source

Not applicable.

d reference to its source - Environment: 2: Manufacture of substance

Not available.

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

d reference to its source - Workers: 1: Manufacture of substance

Not available.

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

nce to DU to evaluate whether he works inside the boundaries set

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion.
A DNEL (derived no effect levels) cannot be derived.
This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance.
However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.
Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.
There are no routine anticipated exposures by ingestion related to any supported uses of the substance. The risk arising from aspiration hazard is solely related to the

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

ibstance or mixture

Mixture

Nytro Libra

re Uses in Functional fluids - Industrial (Other Lubricant Base Oils, IP346<3%, H304)

Identified use name: Functional Fluids - Industrial
Process Category: PROC01, PROC03, PROC08a, PROC08b, PROC02, PROC04, PROC09
Substance supplied to that use in form of: Substance
Sector of end use: SU03
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC07,
Market sector by type of chemical product: Not applicable.
Article category related to subsequent service life: Not applicable.

ing **Functional Fluids**

narios **Functional Fluids**

	9.37.1b
	Concawe 2012
ario	13a
s e	Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in industrial equipment including maintenance and related material transfers.
	Industrial

sure controls

Substance is complex UVCB. Predominantly hydrophobic
Fraction of EU tonnage used in region0.1
Regional use tonnage1.2E+3
Fraction of Regional tonnage used locally1
Annual site tonnage1.0E+1
Maximum daily site tonnage5.0E+2

of Continuous release
Emission Days (days/year)20

t Local freshwater dilution factor 10
Local marine water dilution factor 100

Release fraction to air from process (initial release prior to RMM)5.0E-4
Release fraction to wastewater from process (initial release prior to RMM)1.0E-6
e Release fraction to soil from process (initial release prior to RMM)0.001

d Common practices vary across sites thus conservative process release estimates
evel used.
base

tions Risk from environmental exposure is driven by freshwater sediment.
e or Prevent discharge of undissolved substance to or recover from onsite wastewater.

Section 2 - Exposure controls

Risk management measures - Water	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.4 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of0
Organisational measures to prevent/limit release from site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Conditions and measures related to municipal sewage treatment plant	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal3.3E+3 Assumed on-site sewage treatment plant flow2000
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.

Contributing scenario controlling worker exposure for 0: Functional Fluids	
Product characteristics	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in mixture or article	Covers percentage substance in the product up to 100% (unless stated differently).
Physical state	Liquid With potential for aerosol generation
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently)
Other given operational conditions affecting workers exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician. Contributing scenarios - Operational conditions and risk management measures Bulk transfers - Closed system No other specific measures identified. Drum/batch transfers - Dedicated facility No other specific measures identified. Filling of articles/equipment - closed systems No other specific measures identified. Filling/preparation of equipment from drums or containers - Non-dedicated facility No other specific measures identified. General exposures (closed systems) No other specific measures identified.

osure controls

Remanufacture of reject articles
No other specific measures identified.

Equipment cleaning and maintenance
Drain down system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

res related to personal protection and hygiene
See Section 8 of the safety data sheet (general health and safety measures).
See Section 8 of the safety data sheet (personal protective equipment).

sure estimation and reference to its source

Not applicable.

d reference to its source - Environment: 2: Functional Fluids

Not available.

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

d reference to its source - Workers: 1: Functional Fluids

Not available.

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

nce to DU to evaluate whether he works inside the boundaries set

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion.
A DNEL (derived no effect levels) cannot be derived.
This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance.
However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.
Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.
There are no routine anticipated

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

ubstance or mixture

Mixture

Nytro Libra

e Uses in Functional fluids - Professional (Other Lubricant Base Oils, IP346<3%, H304)

Identified use name: Functional Fluids - Professional
Process Category: PROC01, PROC02, PROC03, PROC08a, PROC09, PROC20
Substance supplied to that use in form of: Substance
Sector of end use: SU22
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC09a, ERC09b, ESVOC SpERC 9.13b.v1
Market sector by type of chemical product: Not applicable.
Article category related to subsequent service life: Not applicable.

ing **Functional Fluids**

narios **Functional Fluids**

	9.38.1b
	Concawe 2012
ario	13b
s e	Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in professional equipment including maintenance and related material transfers.
	Professional

sure controls

Substance is complex UVCB. Predominantly hydrophobic

Fraction of EU tonnage used in region0.1
Regional use tonnage1.2E+3
Fraction of Regional tonnage used locally1
Annual site tonnage6.0E-1
Maximum daily site tonnage1.6E+0

of Continuous release
Emission Days (days/year)365

Local freshwater dilution factor 10
Local marine water dilution factor 100

Release fraction to air from process (initial release prior to RMM)0.05
Release fraction to wastewater from process (initial release prior to RMM)0.025
Release fraction to soil from process (initial release prior to RMM)0.025

d vel ase Common practices vary across sites thus conservative process release estimates used.

ions e or Risk from environmental exposure is driven by freshwater sediment.
If discharging to domestic sewage treatment plant, no onsite wastewater treatment required.

Section 2 - Exposure controls

Risk management measures - Water	Treat on-site wastewater (prior to receiving water discharge) to provide the required removal efficiency of64.9 If discharging to domestic sewage treatment plant, provide the required onsite wastewater removal efficiency of0
Organisational measures to prevent/limit release from site	Do not apply industrial sludge to natural soils. Sludge should be incinerated, contained or reclaimed.
Conditions and measures related to municipal sewage treatment plant	Estimated substance removal from wastewater via on-site sewage treatment94.7 Total efficiency of removal from wastewater after on-site and off-site (domestic treatment plant) RMMs94.7 Maximum allowable site tonnage (M_{Safe}) based on release following total wastewater treatment removal1.1E+1 Assumed on-site sewage treatment plant flow2000
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations.
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.

Contributing scenario controlling worker exposure for 0: Functional Fluids	
Product characteristics	Liquid, vapour pressure < 0.5 kPa at STP
Concentration of substance in mixture or article	Covers percentage substance in the product up to 100% (unless stated differently).
Physical state	Liquid With potential for aerosol generation
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently)
Other given operational conditions affecting workers exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature) Assumes a good basic standard of occupational hygiene is implemented Aspiration hazard if swallowed. Aspiration means the entry of a liquid substance directly into the trachea and lower respiratory tract. Aspiration of hydrocarbon substances can result in in severe acute effects such as chemical pneumonitis, varying degree of pulmonary injury or death. This property relates to the potential for low viscosity material to spread quickly into the deep lung and cause severe pulmonary tissue damage. Classification of a hydrocarbon substance for aspiration hazard is made on the basis of reliable human evidence or on the basis of physical properties. Do not induce vomiting as there is high risk of aspiration. IF SWALLOWED: Immediately call a POISON CENTER or physician. Contributing scenarios - Operational conditions and risk management measures Bulk transfers - Closed system No other specific measures identified. Drum/batch transfers - Dedicated facility No other specific measures identified. Filling of articles/equipment - closed systems No other specific measures identified. Filling/preparation of equipment from drums or containers - Non-dedicated facility No other specific measures identified. General exposures (closed systems) No other specific measures identified.

osure controls

Remanufacture of reject articles
No other specific measures identified.

Equipment cleaning and maintenance
Drain down system prior to equipment break-in or maintenance.

Storage
Store substance within a closed system.

es related to personal protection and hygiene
See Section 8 of the safety data sheet (general health and safety measures).
See Section 8 of the safety data sheet (personal protective equipment).

sure estimation and reference to its source

Not applicable.

d reference to its source - Environment: 2: Functional Fluids
Not available.

The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.

d reference to its source - Workers: 1: Functional Fluids
Not available.

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

nce to DU to evaluate whether he works inside the boundaries set

Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Required removal efficiency for wastewater can be achieved using onsite/offsite technologies, either alone or in combination. Required removal efficiency for air can be achieved using on-site technologies, either alone or in combination. Further details on scaling and control technologies are provided in SpERC factsheet. (http://cefic.org/en/reach-for-Industries-libraries.html) Scaled local assessments for EU refineries have been performed using site-specific data and are attached in PETRORISK file - "Site-Specific Production" worksheet.
The CLP hazard statement H304: May be fatal if swallowed and enters airways (the DPD risk phrase R65: Harmful: may cause lung damage if swallowed) relates to potential for aspiration , a non-quantifiable hazard determined by physico-chemical properties (i.e. kinematic viscosity) that can occur during ingestion and also if it is vomited following ingestion.
A DNEL (derived no effect levels) cannot be derived.
This general qualitative CSA (chemical safety assessment) approach aims to reduce/ avoid contact or incidents with the substance.
However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance.
Exposures should be controlled to at least the levels that represent an acceptable level of risk such that the implementation of the chosen RMMs will ensure that the likelihood of an event occuring due to the substance hazard is negligible, and the risk is considered to be controlled to a level of no concern.

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

For any substance, classifies as H304 (R65), these measures should be communicated via the safety data sheet by use of the following phrase: Do not ingest. If swallowed then seek immediate medical assistance.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

Where other risk management measures/operational conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not support the need for a DNEL to be established for other health effects. Risk management measures are based on qualitative risk characterisation.

„Доставка на електрически апарати 110kV“, реф. № PPD 17-064.

Обособена позиция 2 – Доставка на токови измервателни трансформатори 110kV за монтаж на открито – 21бр.

ПРИЛОЖЕНИЕ 4

AC 117

UT ENERGETYKI (INSTITUTE OF POWER ENGINEERING)
Zespół ds. Certyfikacji (Certification Department)

PRODUCT EVALUATION REPORT

Nr DZC/135c/E/2014-1

and symbol: **HV current transformer, single-phase, outdoor, type: PA 123a**

Sp. z o.o., Oddział w Przasnyszu, ul. Leszno 59, 00 Przasnysz

Warsaw, February 2015 r.

Author: Grażyna Wieczorek M. Sc.

Contents:

Non-conformities observed:

None found

General evaluation result:

Positive
Based on the analysis made , herewith I conclude for granting of compliance certificates to the HV current transformers type PA 123a , with composite or ceramic insulator, manufactured by ABB Sp. z o.o., Oddział w Przasnyszu

Grażyna Wieczorek

26.02.2015

tion

from evaluation of HV overhead, single-phase, current transformer series, types: PA
actured by ABB Sp. z o.o., Oddział w Przasnyszu, was developed within the
process carried out by Zespół ds. Certyfikacji (Certification Team) upon
application (Contract No DZC/135c/E/2014 of the 06th October 2014)
t concerns the new series of current instrument transformers featuring design
nd type marked: PA 123a.
123a current transformers are designed for feeding measurement and protection
rical power grids with the highest system voltage of 123 kV and frequency of 50
sformers consist of a current element located inside an enclosure with a composite
configuration: straight and spiral) or with a ceramic insulator filled with

.23a current transformer series tests were carried out on selected representatives at
of Instytut Energetyki (Institute of Power Engineering) in Warsaw and Instytut
(Electrotechnical Institute) in Warsaw as well as (within the range of product tests
rements) at the manufacturer's laboratory. The selection procedure of
nsformer representatives included the most severe conditions resulting from the
er design and occurring during the temperature-rise tests, short-circuit withstand,
anical tests such as: values of continuous and short-circuit currents, winding wire
ferent main circuits, power of windings for measurement and protection, housing
asses, etc. Tests were carried out on eleven selected transformer prototypes. The
r the entire transformer series acc. to the list as suggested for certification. Test
the transformers features are listed in the reports in cl. 2 of this document. The
mpared against requirements of the following standards:
9-1:2009
nsformers – Part 1: General requirements
-2:2013-06
nsformers – Part 2: Detailed requirements for current transformers
-3:2011
sformers – Part 3: Detailed requirements for voltage transformers
2003
provided by the housing (IP)
2003
otection against external mechanical impacts as provided by electric device
coding)

Customer/manufacturer: ABB Sp. z o.o., Przasnysz holds the complex certificate for the following standards: ISO 9001:2008, ISO 14001:2004 and PN-N-18001:2004 – certificate No 0198 150 01525 issued by TÜV Rheinland Polska Sp. z o.o.

2. List of applied documents

The current transformers design and the test results were evaluated and analysed based on the following documents delivered by the Manufacturer and included in the reports:

D1. Report No EWP/10/E/2014-1e, Temperature-rise test -PVA 145a (360 A), IEn, High Current Laboratory, Warsaw, January 2014

D2. Report No EWP/47/E/2014-1e, Temperature-rise test -PA 145a (1800 A), IEn, High Current Laboratory, Warsaw, January 2014 r.

D3. Report No EWP/35/E/2013-1e, Temperature-rise test -PVA 145a (2400 A), IEn, High Current Laboratory, Warsaw, January 2014 r.

D4. Report No EWP/35/E/2013-2e, Temperature-rise test -PVA 145a (900 A), IEn, High Current Laboratory, Warsaw, January 2014 r.

D5. Test Report No 8595/A/NZL/NBR/15, Temperature-rise test -PA 145a (3000 A), IEl, Distribution Equipment Test Laboratory Warsaw, January 2015 r.

D6. Report No EUR/34/E/14-1 E, Mechanical tests, IEn, Distribution Equipment Laboratory Warsaw, September 2014 r.

D7. Report NoEUR/34/E/14-2 E, Mechanical tests, IEn, Distribution Equipment Laboratory Warsaw, September 2013 r.

D8. Report No EUR/34/E/14-3 E, Mechanical tests, IEn, Distribution Equipment Laboratory Warsaw, September 2014 r.

D9. Report No EUR/34/E/14-4 E, Mechanical tests, IEn, Distribution Equipment Laboratory Warsaw, September 2014 r.

D10. Report No EUR/71/E/13-3 E, Short-time current test, Test for composite error, test of strength against short-circuit in the secondary circuit, IEn, Distribution Equipment Laboratory Warsaw, January 2014 r.

D11. Report No EUR/74/E/13 E, Short-time current test, Test for composite error, IEn, Distribution Equipment Laboratory Warsaw, December 2013 r.

D12. Test Report No 8596/A/NZL/NBR/15, Short-time current test, IEl, Distribution Equipment Test Laboratory Warsaw, January 2015 r.

D13. Report No EUR/71/E/13-4 E, Short-time current test, Test for composite error, IEn, Distribution Equipment Laboratory Warsaw, January 2014 r.

D14. Report No EUR/23/E/14 E, Short-time current test, Test for composite error, IEn, Distribution Equipment Laboratory Warsaw, May 2014 r.

D15. Test Report No EWN/145/E/13 Type tests, special tests and additional tests of combined transformers type PVA123a i PVA145a manufactured by ABB sp. z o.o., IEn, High Voltage Laboratory, Warsaw, January 2014 r.

t No Nr EWN/11/E/12-1, Type tests, special tests and additional tests of Voltage
PV 123, manufactured by ABB sp. z o.o., IEn, High Voltage Laboratory Warsaw,

t No Nr EWN/11/E/12-2, tests of Current transformer type PA 123 (PA 145) with
LI 650kV/AC 275kV, manufactured by ABB sp. z o.o., IEn, High Voltage
saw, October 2012 r.

EWP/35/E/2013-3e) , Sprawdzenie ochrony przed uderzeniem mechanicznym, IEn,
boratory, Warsaw, February 2014 r.

8281/A/NZL/NBR/12), IP tests for terminal box, IEl, Distribution Equipment Test
saw, Warsaw, July 2012 r.

nal drawings:
ional drawing Combined instrument transformer PVA 123a-145a
2GKK614122/ABB R&D_TS_KU568/13 (17.12.2013),
ional drawing Combined instrument transformer PVA 123a-145a
2GKK614123/ABB R&D_TS_KU571/13 (17.12.2013),
ional drawing Combined instrument transformer PVA 123a-145a
2GKK614123/ABB R&D_TS_KU572/13 (17.12.2013),
ional drawing Combined instrument transformer PVA 123a-145a
2GKK614120/ABB R&D_TS_KU569/13/A (17.12.2013),
ional drawing Combined instrument transformer PVA 123a-145a
2GKK614121/ABB R&D_TS_KU569/13 (17.12.2013),
ional drawing Current transformer PA 145, 2GKA612004 (01.08.2014),
ional drawing Current transformer PA 145, 2GKA612002 (11.09.2014),
ional drawing Current transformer PA 145, 2GKA612001 (11.09.2014),
ional drawing Current transformer PA 145, 2GKA612003 (11.09.2014),
ional drawing Voltage transformer PV 123, 2GKV614114/ (19.01.2012),
ional drawing Current transformer PA 123 (PA 145), 2GKA614117 (19.01.2012),
ional drawing Current transformer PA 145, 2GKA612004 (01.08.2014),
ional drawing Current transformer PA 145, 2GKA614301 (01.08.2014).

st reports and accuracy check reports – see reports from tests D1÷D5, D10÷D17

ites – see reports from tests D1÷19

diagrams – see reports from testsD1÷D5, D10÷D17

rer's Statement issued on 2nd March 2015 r. –concerns total active power dissipated in
ner windings.

boratory competences

tine tests and special tests for PA...a transformers were carried out at the following

n Wysokich Napięć (High Voltage Laboratory), a unit of Instytut Energetyki (Institute
gineering) in Warsaw, holding the PCA Accreditation Certificate of the Research
CA No AB 272.

n Urządzeń Rozdzielczych (Distribution Equipment Laboratory), a unit of Instytut

- Laboratorium Wielkoprądowe (High Current Laboratory), a unit of Instytut Energetyki (Institute of Power Engineering) in Warsaw, holding the PCA Accreditation Certificate of the Research Laboratory PCA Nr AB 323.
- Laboratorium Fabryczne ABB Sp. z o.o. (ABB Manufacturing Plant Laboratory) in Przasnysz – Punkt Legalizacyjny OUM Warszawa (OUM Warsaw Verification Unit) – deviation measurement, and product tests under supervision of Instytut Energetyki (Institute of Power Engineering), Laboratorium Wysokich Napięć (High Voltage Laboratory).
- Laboratorium Badawcze Aparatury Rozdzielczej (Distribution Equipment Test Laboratory), a unit of Instytut Elektrotechniki (Electrotechnical Institute) in Warsaw, holding the PCA Accreditation Certificate of the Research Laboratory PCA No AB 074.

4. Test result list

4.1. Type tests and additional tests

The tests were made on selected PA ...a, PVA ...a and PV ... transformer designs (various rated currents for the current elements, various main circuit designs, various design of secondary circuits, different accuracy classes and various insulation covers, etc.) The tests results are valid for the entire transformer series acc. to the list as suggested for certification. Table 1 shows produced by manufacturer's solutions for the main circuits of current transformers. Representative designes for short-circuit tests and temperature-rise tests were selected from that list.

PVA...a and PA ...a transformers were selected to temperature-rise test based on the most heat-exposed design solutions.

Dielectric tests were made for two transformers type : PVA 123a, and 145a as well as PA 123 (145) and PV 123.

The short-circuit withstand tests were made for PVA...a and PA ...a transformers. Representatives designs were selected according to their main circuits exposition to dynamic and thermal effects.

Table 2 shows performed tests. Their scope meets requirements included in respective standards for: type tests, special tests, routine tests, and some additional requirements. Respective item numbers in PN-EN 61869 and IEC 61869 as well as report numbers with detailed test results are listed.

Results of all tests were positive.

tine tests

ne tests and accuracy class tests were carried out at the manufacturer's laboratory for rmers tested under the IEn supervision.

uded:

nents before filling the instrument transformer,
of markings of terminals,
ency voltage withstand tests on primary terminals,
ency voltage withstand tests on secondary terminals,
rge intensity,
insulation test,
racy,
coefficient determination,
characteristics determination,
of capacitance and dielectric dissipation factor,
ance measurement.

ults were listed in protocols, their numbers being the same as that of the transformer
e voltage tests and short circuit tests, additional routine tests and accuracy class tests
t.

sitive

circuit list:

urrent circuit assembly awing number	Drawing title	Max current Icth	Max current Ith (1s) /Idyn	Performed positive tests with current Icth	Performed positive tests with current Ith (1s)/Idyn
KKI14130A000 1	Main circuit, rod ϕ40 Cu	3000 A	63/158 kA (40 kA/3s)	PA 145a 8595/NZL/NBR/15	PA 145a 8596/NZL/NBR/15
KKI14131A000 1	Main circuit, rod ϕ40 Al	2400 A	63/158 kA	PVA 145a EWP/35/E/2013-1	PVA 145a EUR/74/E/13
KKI14132A000 1	Main circuit, rod ϕ40 Al + rura ϕ60x4 Al	2400A -1800 A	63-63/ 158-158 kA	PVA 145a EWP/35/E/2013-1 PA 145a EWP/47/E/2014-1	PVA 145a EUR/74/E/13
KKI14133A000 1	Main circuit, rod ϕ40 Al + rura ϕ60x4Al + 2 turns of cable 240mm2	2400A -1800A -900 A	63-63--40/158-158-100 kA	PA 145a EWP/47/E/2014-1 PVA145a EWP/35/E/2013-1 EWP/35/E/2013-2[1)]	PVA 123a EUR/71/E/13-3
KKI14134A000 1	Main circuit 1 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
KKI14134A000 2	Main circuit 2 turns of cable 240	900 A	40/100 kA	PVA 145a	

3 turns of cable 240mm2	2GKKI14134A000 3	Main circuit 3 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
4 turns of cable 240mm2	2GKKI14134A000 4	Main circuit 4 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
5 turns of cable 240mm2	2GKKI14134A000 5	Main circuit 5 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
6 turns of cable 240mm2	2GKKI14134A000 6	Main circuit 6 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
7 turns of cable 240mm2	2GKKI14134A000 7	Main circuit 7 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a - NF 86144 EUR/23/E/14
8 turns of cable 240mm2	2GKKI14134A000 8	Main circuit 8 turns of cable 240 mm2	900 A	40/100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
2+2 turns of cable 240mm2	2GKKI14135A000 1	Main circuit 2+2 turns of cable 240 mm2	900 A – 900 A	40-40/ 100-100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
3+3 turns of cable 240mm2	2GKKI14135A000 2	Main circuit 3+3 turns of cable 240 mm2	900 A – 900 A	40-40/ 100-100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
4+4 turns of cable 240mm2	2GKKI14135A000 3	Main circuit 4+4 turns of cable 240 mm2	900 A – 900 A	40-40/ 100-100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
2+2+4 turns of cable 240mm2	2GKKI14136A000 1	Main circuit 2+2+4 turns of cable 240 mm2	900 A – 900 A -900 A	40-40-40/100-100-100 kA	PVA 145a EWP/35/E/2013-2[1)]	PVA 145a EUR/23/E/14
3 turns of cable 120mm2	2GKKI14137A000 1	Main circuit 3 turns of cable 120mm2	360 A	20/50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
6 turns of cable 120mm2	2GKKI14137A000 2	Main circuit 6 turns of cable 120mm2	360 A	20/50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
9 turns of cable 120mm2	2GKKI14137A000 3	Main circuit turns of cable 120mm2	360 A	20/50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
12 turns of cable 120mm2	2GKKI14137A000 4	Main circuit 12 turns of cable 120mm2	360 A	20/50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
3+3 turns of cable 120mm2	2GKKI14138A000 1	Main circuit 3+3 turns of cable 120 mm2	360 A – 360 A	20-20 / 50-50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
6+6 turns of cable 120mm2	2GKKI14138A000 2	Main circuit 6+6 turns of cable 120 mm2	360 A – 360 A	20-20 / 50-50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
3+3+ turns of cable 120mm2	2GKKI14139A000 1	Main circuit 3+3+5 turns of cable 120mm2	360 A – 360 A –360 A	20-20-20/50-50-50 kA	PVA 145a EWP/10/E/2014-1	PVA 145a EUR/71/E/13-4
Rod ϕ40 Cu + pipe ϕ60x4 Al	2GKKI14159A000 1	Main circuit rod ϕ40 Cu + pipe ϕ60x4 Al	3000 A- 1800 A	63-63/158-158 kA (40 kA/3s)	PA 145a EWP/47/E/2014-1 8595/NZL/NBR/15	PA 145a 8596/NZL/NBR/15

[1)] See Manufacturer's Statement issued on 02.03.2015 r. concerning limitation of active power of windings resistance to 80 W.

Table 2. List of tests made for type PA...a current transformer

Item	Test type	Requirements	Report numbers
	TYPE TESTS		
1	Short-time current test	PN EN 61869-2, p.7.2.201	8596/NZL/NBR/15 EUR/71//E/13-3 EUR/71//E/13-4 EUR/74//E/13

		EWP/35/E/2013-2 8595/NZL/NBR/15
tage withstand test	PN-EN 61869-1, p.7.2.3 PN EN 61869-2, p. 7.2.3	EWN/145/E/13
outdoor type s	PN-EN 61869-1, p.7.2.4 PN-EN 61869-2, p.7.2.4	EWN/11/E/12-1 EWN/11/E/12-2
curacy	PN EN 61869-2, p. 7.2.6.201 + 203	EWN/145/E/13 and protocols from manufacturer's laboratory
	PN EN 61869-1, p. 7.2.5.1	EWN/145/E/13
mposite error	PN EN 61869-2, p. 7.2.6.203	EUR/71//E/13-3 EUR/71//E/13-4 EUR/74/E/13 EUR/23/E/14
ox verification of the IP	PN EN 61869-1, p. 7.2.7.1 PN-EN 60529, p.13.14	8281/NZL/NBR/12
l impact test (IK)	PN EN 61869-1, p. 7.2.7.2 PN-EN 62262	EWP/35/E/2013-3
SPECIAL TESTS		
pulse voltage withstand test erminals	PN-EN 61869-1, p.7.4.1 PN EN 61869-2, p. 7.4.1	EWN/145/E/13
test	PN-EN 61869-1, p.7.4.5	EUR/34/E/14-1 EUR/34/E/14-2 EUR/34/E/14-3 EUR/34/E/14-4
overvoltage test	PN-EN 61869-1, p.7.4.4	EWN/145/E/13
nt of capacitance and issipation factor	PN-EN 61869-1, p.7.4.3 PN EN 61869-2, p. 7.4.3	and protocols from manufacturer's laboratory

e test results for selected representatives of transformers series type PA 123a and
45a and PV 123 As well as on analysis of the standards, it was found that:

formed all tests from the type test range, special tests and additional tests sufficient
evaluation of the apparatuses.

nsformer errors tests and instrument transformer secondary circuit designs were
heir metrological properties were confirmed.

rument transformer main circuit designs were analysed. It was found out that the
sts and temeprsature-rise tests as carried out are binding for all design solutions.

de according to requirements of the 61869 series standard (PN and IEC)

results under consideration, the technical data listed in Table 3 may be referenced to

- This document may be a basis for issuing compliance certificates for PA 123a instrument transformer series manufactured by ABB Sp. z o.o. Oddział w Przasnyszu. The certificate validity date is suggested to be November 2017.

Table 3. List of technical data assigned to PVA 123a

Transformer type PA 123a	
Highest voltage of current transformer [U_m]	≤ 123 kV
Rated frequency [f_R]	50 Hz
Rated insulation level	AC 230 kV / LI 550 kV
Burden class	F_R=3600N
External insulation – minimal creepage distance of insulator: • ceramic insulator • composite insulator	 3640 mm 3800 mm
Degree of protection to mechanical impact of enclosure [1)]	IK7
Degree of protection of secondary terminal enclosure	IP55
Current element	
Rated primary current [I_{pr}]	50 A + 3 000 A
Extended current rating	do 200%
Rated continuous thermal current [I_{cth}]	≤ 3000 A
Rated short-time thermal current [I_{th}] during 1 s	20 kA lub 40 kA lub 63kA
Rated short-time thermal current [I_{th}] during 3 s	20 kA lub 40kA
Rated dynamic current [I_{dyn}]	50 kA lub 100 kA lub 158 kA
Rated secondary current [I_{sr}]	1 A lub 5 A
Core power to measurements and to protection (S_r)	1VA – 200 VA
Measure core accuracy class (cl.)	0,1; 0,2; 0,2S; 0,5; 0,5S; 1; 3; 5
Protective core accuracy class (cl.)	5P; 10P; 5PR; 10PR; PX; PXR; TPX; TPY; TPZ

REMARKS: [1)] Do not apply to ceramic insulators

APPENDIX

ports, special test reports and manufacturers statements (pages not numbered)

VP/10/E/2014-1e, Temperature-rise test – PVA 145a (360 A), IEn, High Current Laboratory, Warsaw,

/P/47/E/2014-1e, Temperature-rise test -PA 145a (1800 A), IEn, High Current Laboratory, Warsaw,

/P/35/E/2013-1e, Temperature-rise test -PVA 145a (2400 A), IEn, High Current Laboratory, Warsaw,

/P/35/E/2013-2e, Temperature-rise test -PVA 145a (900 A), IEn, High Current Laboratory, Warsaw,

8595/A/NZL/NBR/15, Temperature-rise test -PA 145a (3000 A), IEl, Distribution Equipment Test
w, January 2015 r.

R/34/E/14-1 E, Mechanical tests, IEn, Distribution Equipment Laboratory, Warsaw, September 2014

R/34/E/14-2 E, Mechanical tests, IEn, Distribution Equipment Laboratory, Warsaw, September 2013

/34/E/14-3 E, Mechanical tests, IEn, Distribution Equipment Laboratory, Warsaw, September 2014

/34/E/14-4 E, Mechanical tests, IEn, Distribution Equipment Laboratory, Warsaw, September 2014

R/71/E/13-3 E), Short-time current test, Test for composite error, test of strength against short-
ary circuit, IEn, Distribution Equipment Laboratory, Warsaw, January 2014 r.

R/74/E/13 E Short-time current test, Test for composite error, IEn, Distribution Equipment
, December 2013 r.

8596/A/NZL/NBR/15, Short-time current test, IEl, Distribution Equipment Test Laboratory,
15 r.

R/71/E/13-4 E, Short-time current test, Test for composite error, IEn, Distribution Equipment
, January 2014 r.

/23/E/14 E, Short-time current test, Test for composite error, IEn, Distribution Equipment
May 2014 r.

EWN/145/E/13, Type tests, special tests and additional tests of combined transformers type
produkcji ABB sp. z o.o., IEn, High Voltage Laboratory, Warsaw, January 2014 r.

EWN/11/E/12-1, Type tests, special tests and additional tests of current transformer type PV 123,
B sp. z o.o., IEn, High Voltage Laboratory, Warsaw, October 2012 r.

EWN/11/E/12-2, Tets of current transformer type PA 123 (PA 145) with dielectric level LI
anufactured by ABB sp. z o.o., IEn, High Voltage Laboratory, Warsaw, October 2012 r.

/35/E/2013-3e) , Mechanical impact test, IEn, High Current Laboratory, Warsaw, February 2014

A/NZL/NBR/12 IP tests for terminal box, IEl, Distribution Equipment Test Laboratory, Warsaw,

on 2nd March 2015 r. refers to the total active power dissipated in the current transformer

INSTITUTE OF POWER ENGINEERING
DISTRIBUTION EQUIPMENT LABORATORY

01-330 Warsaw, ul Mory 8
tel.fax. +48 22 836-73-35
tel. +48 22 345-13-86
http://www.ien.com.pl/eur

TEST REPORT No. EUR/34/E/14-3 E

Current transformer type PA 145a with porcelain insulator
Serial No. 2GKP014A1287182

ER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

ED BY: ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa
order No. 4500574872 dated 22.07.2014

S: Mechanical tests

DURE: According to IEC 61869-1:2007 p. 7.4.5

S: 22.08.2014

T: Positive for
$F_R = 3600$ N

Tests result refers only to the test object

ERE
Y: -

gineer

czmarczyk

HEAD OF LABORATORY

Lidia Gruza

Contents **Page**

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photographs	6

BJECT

cription

transformer type PA 145a is used for supplying of measuring and protection circuits
of maximum operating voltage 145 kV and frequency 50 Hz. The transformer
urrent transformer mounted housing with porcelain insulator immersed with

nical data

nufacturer attributed the following construction data to the test object.

ating voltage	145 kV
	50 Hz
1	3600 N

nical documentation

urpose of tests the orderer delivered the following technical documentation:
awing current instrument transformer PA 145a, No. 2GKK612001, 11.09.2014,

sformer electrical diagram
3 Sp. z o.o. (Annex 2).

roceeded the identification of test object on the base of above documentation and

aration for tests

bject was prepared for test by factory.

TESTS

am, agreed with orderer, comprised the following tests according to requirements
007:
s acc. to item 7.4.5 of above standard for F_R = 3600 N of P1 and P2 150 A

eflection of the transformer shall be recorded.

MEASURING CIRCUITS

s the transformer was fixed to the rigid construction of the test stand.
were performed applying the load consecutively to the transformer's P1 and
s as shown on photographs in Annex 1.

4. TESTS AND THEIRS DETAILED RESULTS

Tests results presents table 1. The load was increased and released smoothly (30 – 90 s) and was maintained 60 s.

During the tests the following records were made:

- phot. 1 to 6 - current transformer during mechanical tests.

(Annex 1 presents the photographs)

Table 1. Results of static load withstand tests at F = 3620 N

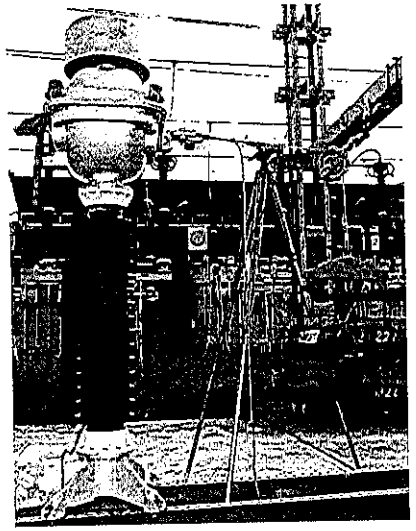
Test No.	Terminal	Load direction	Test time	Observations
-	-	-	s	-
1	P1	longitudinal	60	During the static load deflection was 9,0 mm. Residual deflection was 1,5 mm. After tests no damage nor oil leak was stated.
2	P1	transverse	60	During the static load deflection was 9,7 mm. Residual deflection was 1,6 mm. After tests no damage nor oil leak was stated.
3	P1	vertical	60	During the static load deflection was 3,2 mm. Residual deflection was 0,1 mm. After tests no damage nor oil leak was stated.
4	P2 150 A	longitudinal	60	During the static load deflection was 7,8 mm. Residual deflection was 1,1 mm. After tests no damage nor oil leak was stated.
5	P2 150 A	transverse	60	During the static load deflection was 9,0 mm. Residual deflection was 1,4 mm. After tests no damage nor oil leak was stated.
6	P2 150 A	vertical	60	During the static load deflection was 3,0 mm. Residual deflection was 0,2 mm. After tests no damage nor oil leak was stated.

5. TESTS RESULTS EVALUATION

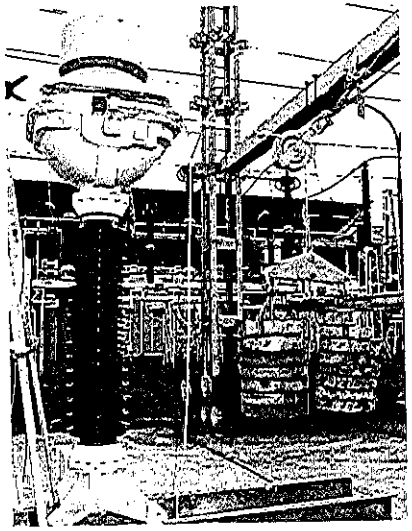
According to criteria given in IEC 61869-1:2007 p. 7.4.5 the results of tests of tested current transformer is positive for:

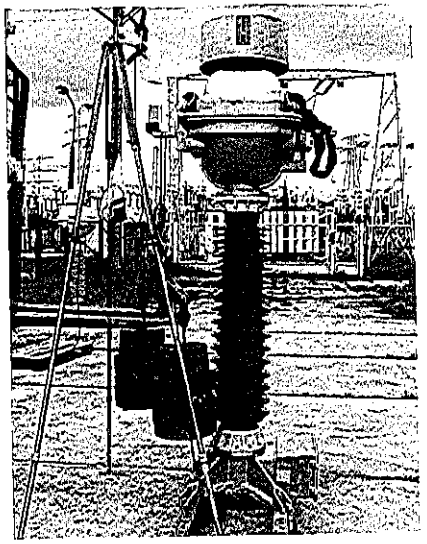
F_R = 3600 N.

Photographs taken during the tests

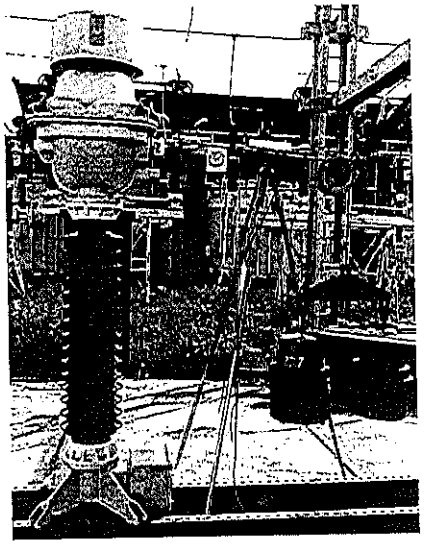


Phot. 1. Longitudinal load of terminal P1

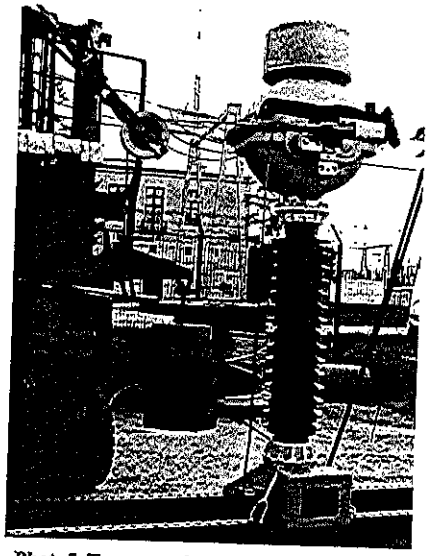




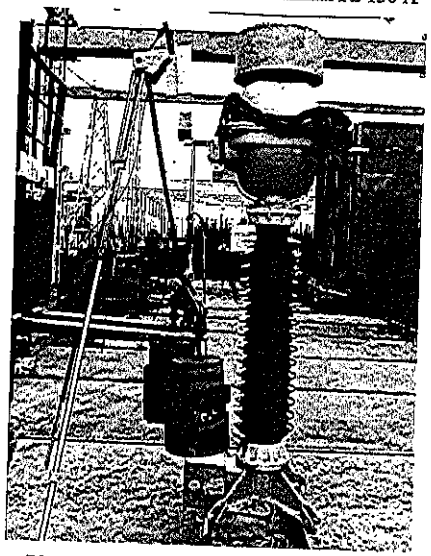
Phot. 3. Vertical load of terminal P1



Phot. 4. Longitudinal load of terminal P2 150 A

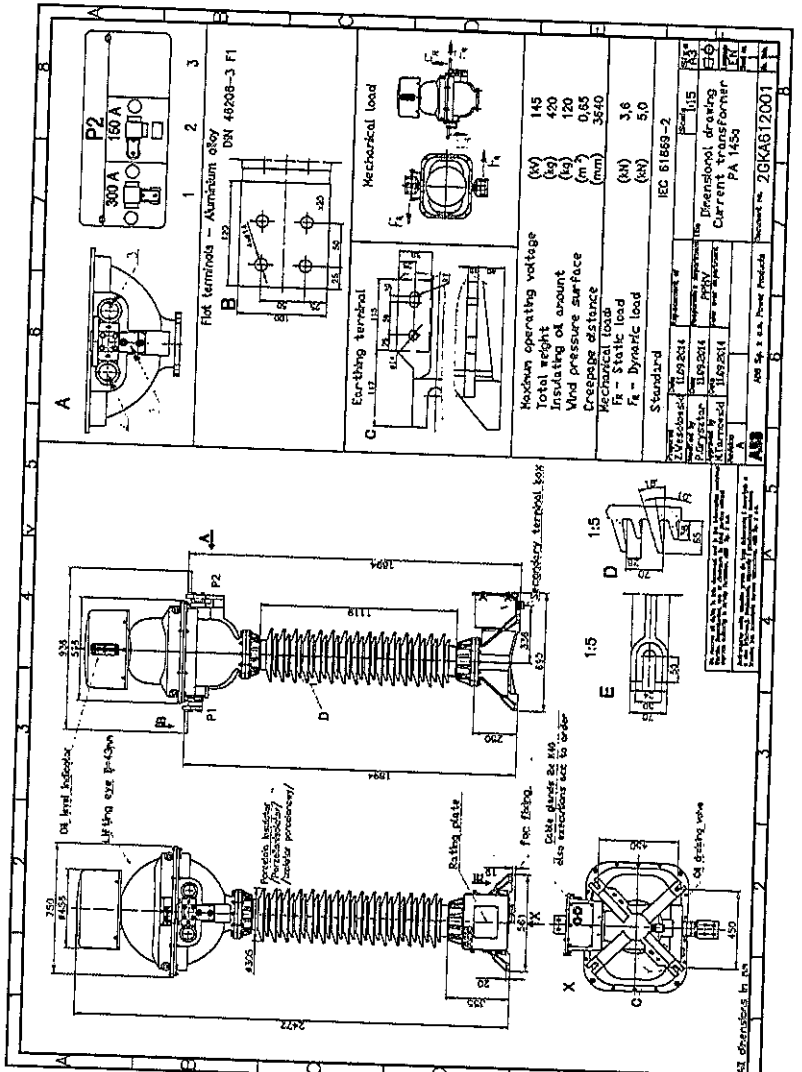


Phot. 5. Transverse load of terminal P2 150 A



Phot. 6. Vertical load of terminal P2 150 A

ANNEX 2 **Documentations delivered by orderer**



BB

nt Transformer

Type: PA 145a

el	145/275/650 kV	Standard	PN-EN 61869-2	fn	50 Hz
	Nytro Libra	Weight / Oil weight	420 / 120 kg	Temp. range	-40°C— +40°C
	KP014A1287182				

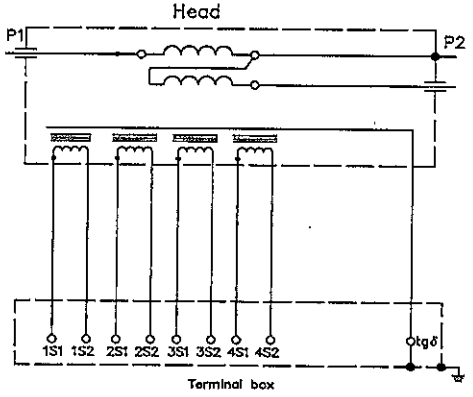
K_n 150-300/5-1-5-1 A/A

$I_{th}/1s$ 20-20 kA I_{dyn} 50-50 kA

I_{cth} 180-360 A

	A	VA	Class	FS/ALF	Ext.%
1S1-1S2	5	30	0,2	5	120
2S1-2S2	1	40	5P	20	
3S1-3S2	5	60	5P	20	
4S1-4S2	1	60	5P	20	
5S1-5S2					
6S1-6S2					

Transportation: Vertical / Horizontal



nstrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 – XS2
. DURING INSTRUMENT TRANSFORMER OPERATION TERMINAL tgδ MUST BE EARTHED

INSTITUTE OF POWER ENGINEERING
DISTRIBUTION EQUIPMENT LABORATORY

01-330 Warsaw, ul Mory 8
tel.fax. +48 22 836-73-35
tel. +48 22 345-13-86
http://www.ien.com.pl/eur

TEST REPORT No. EUR/34/E/14-4 E

Current transformer type PA 145a with porcelain insulator
Serial No. 2GKP014A1287181

ER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

D BY: ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa
order No. 4500574872 dated 22.07.2014

: Mechanical tests

URE: According to IEC 61869-1:2007 p. 7.4.5

S: 27.08.2014

: Positive for
$F_R = 3600$ N

Tests result refers only to the test object

RE
Y: -

ineer

zmarczyk

HEAD OF LABORATORY

Lidia Gruza

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BJECT

cription

transformer type PA 145a is used for supplying of measuring and protection circuits of maximum operating voltage 145 kV and frequency 50 Hz. The transformer urrent transformer mounted housing with porcelain insulator immersed with

nical data

ufacturer attributed the following construction data to the test object.

ting voltage	145 kV
	50 Hz
	3600 N

nical documentation

rpose of tests the orderer delivered the following technical documentation:
awing current instrument transformer PA 145a, No. 2GKK612003, 11.09.2019,

sformer electrical diagram
Sp. z o.o. (Annex 2).

oceeded the identification of test object on the base of above documentation and

ration for tests

ject was prepared for test by factory.

TESTS

am, agreed with orderer, comprised the following tests according to requirements 007:

s acc. to item 7.4.5 of above standard for F_R = 3600 N of P1 and P2 600 A

flection of the transformer shall be recorded.

MEASURING CIRCUITS

s the transformer was fixed to the rigid construction of the test stand.
were performed applying the load consecutively to the transformer's P1 and as shown on photographs in Annex 1.

4. TESTS AND THEIRS DETAILED RESULTS

Tests results presents table 1. The load was increased and released smoothly (30 – 90 s) and was maintained 60 s.

During the tests the following records were made:

- phot. 1 to 6 - current transformer during mechanical tests.

(Annex 1 presents the photographs)

Table 1. Results of static load withstand tests at F = 3620 N

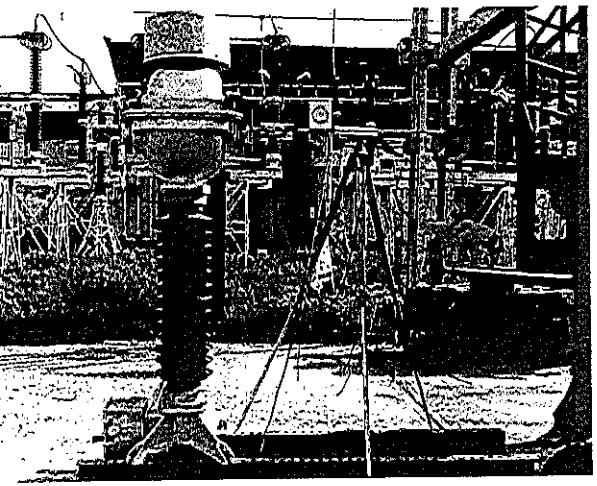
Test No.	Terminal	Load direction	Test time	Observations
-	-	-	s	-
1	P1	longitudinal	60	During the static load deflection was 7,5 mm. Residual deflection was 0,3 mm. After tests no damage nor oil leak was stated.
2	P1	transverse	60	During the static load deflection was 4,3 mm. Residual deflection was 0,8 mm. After tests no damage nor oil leak was stated.
3	P1	vertical	60	During the static load deflection was 3,1 mm. Residual deflection was 0,2 mm. After tests no damage nor oil leak was stated.
4	P2 600 A	longitudinal	60	During the static load deflection was 8,4 mm. Residual deflection was 0,7 mm. After tests no damage nor oil leak was stated.
5	P2 600 A	transverse	60	During the static load deflection was 9,2 mm. Residual deflection was 0,5 mm. After tests no damage nor oil leak was stated.
6	P2 600 A	vertical	60	During the static load deflection was 2,7 mm. Residual deflection was 0,2 mm. After tests no damage nor oil leak was stated.

5. TESTS RESULTS EVALUATION

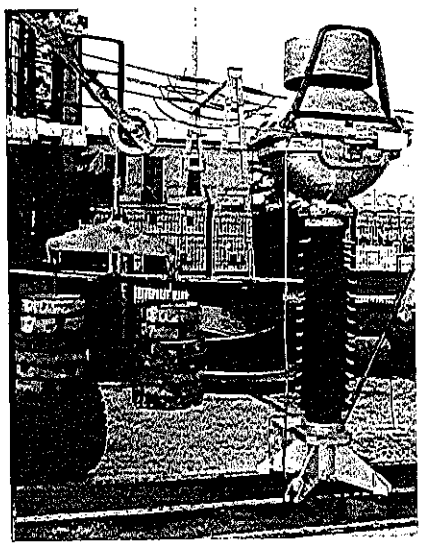
According to criteria given in IEC 61869-1:2007 p. 7.4.5 the results of tests of tested current transformer is positive for:

F_R = 3600 N.

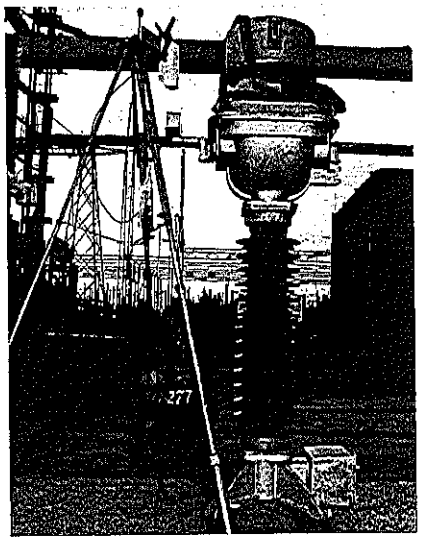
Photographs taken during the tests



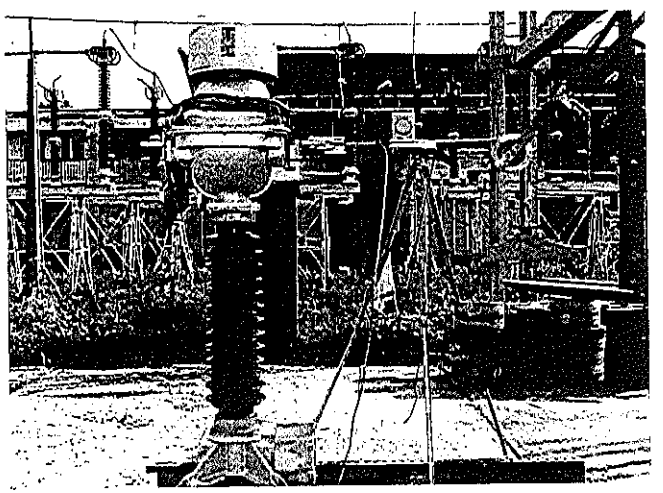
Phot. 1. Longitudinal load of terminal P1



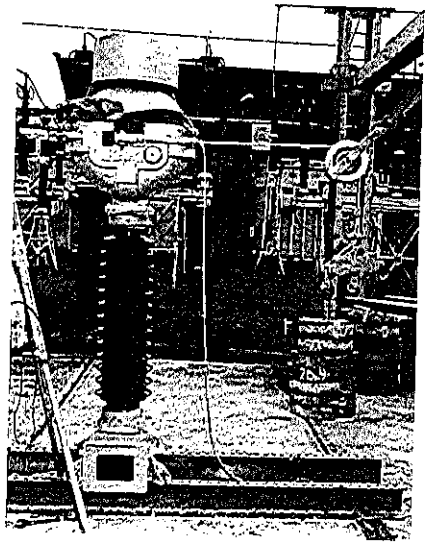
Phot. 2. Transverse load of terminal P1



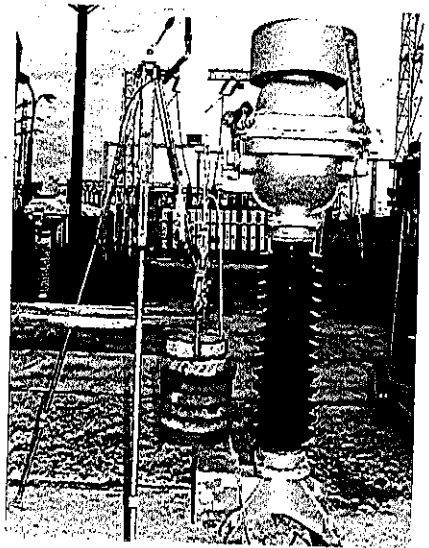
Phot. 3. Vertical load of terminal P1



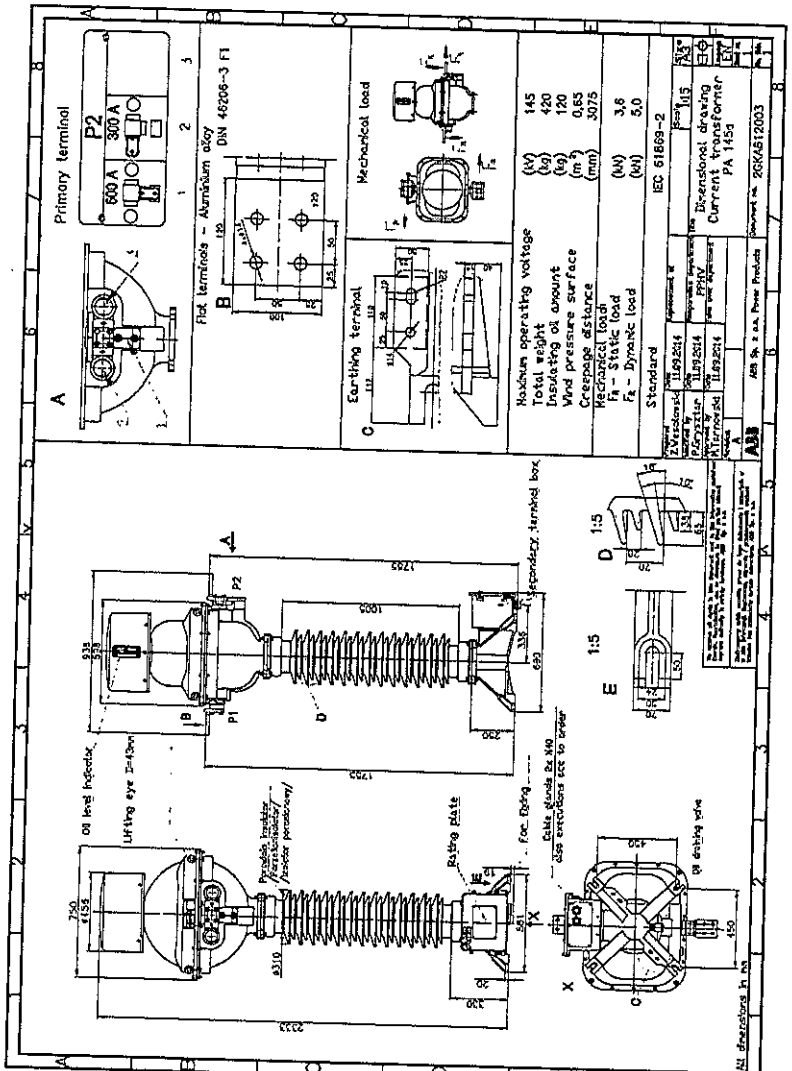
Phot. 4. Longitudinal load of terminal P2 600 A



Phot. 5. Transverse load of terminal P2 600 A



ANNEX 2 **Documentations delivered by orderer**



ABB

ent Transformer

vel	145/275/650 kV	Standard	IEC 61869-2	fn	50 Hz
	Nytro Libra	Weight / Oil weight	420 / 120 kg	Temp. range	-40°C→ +40°C
	GKP014A1287181				

Type: PA 145a

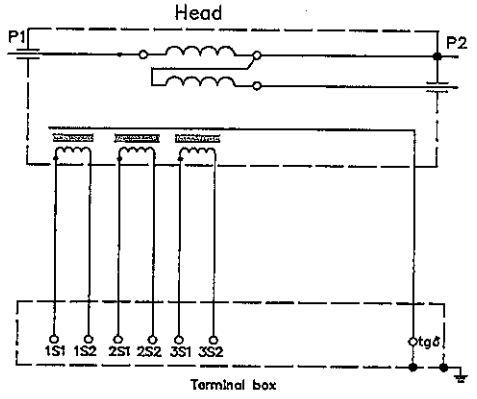
K_n: 300-600/5-5-1 A/A

I_{th}/1s: 40-40 kA I_{dyn}: 100-100 kA

I_{cth}: 450-900 A

	A	VA	Class	FS/ALF	Ext.%
1S1-1S2	5	40	0,2	5	150
2S1-2S2	5	60	5P	20	
3S1-3S2	1	120	10P	15	
4S1-4S2					
5S1-5S2					
6S1-6S2					

Transportation: Vertical / Horizontal



Instrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 – XS2
2. DURING INSTRUMENT TRANSFORMER OPERATION TERMINAL tgδ MUST BE EARTHED

INSTITUTE OF POWER ENGINEERING
DISTRIBUTION EQUIPMENT LABORATORY

01-330 Warsaw, ul Mory 8
tel.fax. +48 22 836-73-35
tel. +48 22 345-13-86

TEST REPORT No. EUR/71/E/13-3 E

Combined instrument transformer type PVA 123a with composite insulator
Serial No. 2GKP013K1486138

ER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

D BY: Internal order No. EWN/145/E/13 dated 12.12.2013

S: Short-time current tests
Test for composite error
Short-circuit withstand capability test

URE: According to IEC 61869-2:2012 and IEC 61869-3:2011

S: 16/17.12.2013

T: Positive for
I_{dyn} = 158 kA, I_{th} = 63 kA, t = 1 s for 100 A terminal
I_{dyn} = 100 kA, I_{th} = 40 kA, t = 1 s for 50 A terminal
63,5 kV at short-circuit in secondary circuits of VT

Tests result refers only to the test object

ERE
Y: M. Tarnowski, Z. Wesołowski – ABB Sp. z o.o.

ineer

zmarczyk

HEAD OF LABORATORY

Lidia Gruza

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BJECT

cription

ed instrument transformer type PVA 123a is used for supplying of measuring and its in the network of maximum operating voltage 126 kV and frequency 50 Hz. The nsists of current and voltage transformers mounted in common housing with ator immersed with transformer oil.

hnical data

ufacturer attributed the following construction data to the test object.

ting voltage		126 kV	
		50 Hz	
s thermal current	50 A	100 A	200 A
current for 1 s	100 A	200 A	400 A
urrent	40 kA	63 kA	63 kA
	100 kA	158 kA	158 kA

nical documentation

e of tests the orderer delivered the following technical documentation:
wing combined transformer PVA 123a-145a, No. 2GKK614122 (17.12.2013),
ort of combined instrument transformer (12.11.2013),
ort of combined instrument transformer after short-time current test (24.01.2013),

former electrical diagram
Sp. z o.o (Annex 3 and 4).
oceeded the identification of test object on the base of above documentation and
onformity of manufacturing with constructional documentation is stated
declaration, copy of which presents Annex 4.

ration for tests

was prepared for tests in the factory by the manufacturer.

TESTS

greed with orderer, comprised the following tests according to requirements of and IEC 61869-3:2011:

ent tests of current transformer acc. to item 7.2.201 of above standard at

kA, I_{th} = 63 kA, t_{th} = 1 s, $I_{th}^2 \times t_{th} \geq 3969$ kA^2×s for 100 A terminal.
kA, I_{th} = 40 kA, t_{th} = 1 s, $I_{th}^2 \times t_{th} \geq 1600$ kA^2×s for 50 A terminal.

error acc. to item 7.2.6.203 of above standard with current's transformer burden nnected to 4S1-4S2 windings at parameters:
kA, t_{th} = 1 s for 50 A terminal,

withstand capability test acc. to item 7.2.301 of above standards at parameters:
63,5 kV, t_p = 1 s.

and after short-time current test made in factory.

3. TEST AND MEASURING CIRCUITS

For the tests the transformer was fixed to the rigid construction of the test stand. Short-time current tests and test for composite error were made in one-phase circuit presented on fig. 1 at dimensions presented on fig.2. Short-circuit withstand capability test were made in one phase circuit presented on fig. 3.
The following quantities were recorded during short-time current tests and test for composite error using digital recorder type HIOKI 8842:

- primary current (with short-circuited all secondary terminals) during short-time current tests using laboratory current transformer type CdC class 0,5 with a ratio 50.000/2 A/A (uncertainty of measurement ±0,018% for k = 2),
- secondary currents in -1S2, 3S1-3S2 and 4S1-4S2 windings by means of laboratory toroidal current transformers type IL20a class 0,5 with a ratio 1.000/5 A/A, 2.000/5 A/A and 5.000/5 A/A (uncertainty of measurement ±0,012% for k = 2),.
- voltage drop (U_0) on test object during short-time current tests by means of a resistance-capacitance voltage divider with a bandwidth from 0 to 100 kHz.

The following quantities were recorded during short-circuit withstand capability tests using digital recorder type HIOKI 8842:

- primary voltage and current, secondary current in short-circuited windings: 1a-1n (next 4a-4n and da-dn) during short-circuit withstand capability tests of voltage transformer using:
  - inductive voltage transformer type U110a class 0,5 with a ratio 110/√3/0,1/√3 kV/kV for primary voltage measurement,
  - laboratory current transformer type GE 4461 class 0,2 with a ratio 5/5 A/A for primary current measurement (uncertainty of measurement ±0,013% for k = 2),
  - laboratory current transformer type IL 20a class 0,5 with a ratio 2.000/5 A/A for secondary currents measurements (uncertainty of measurement ±0,012% for k = 2).

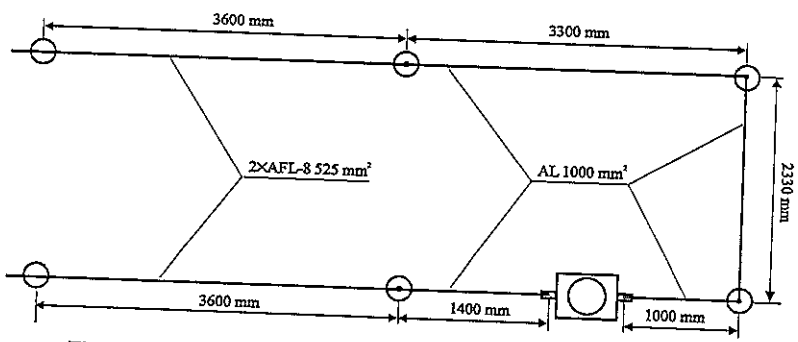
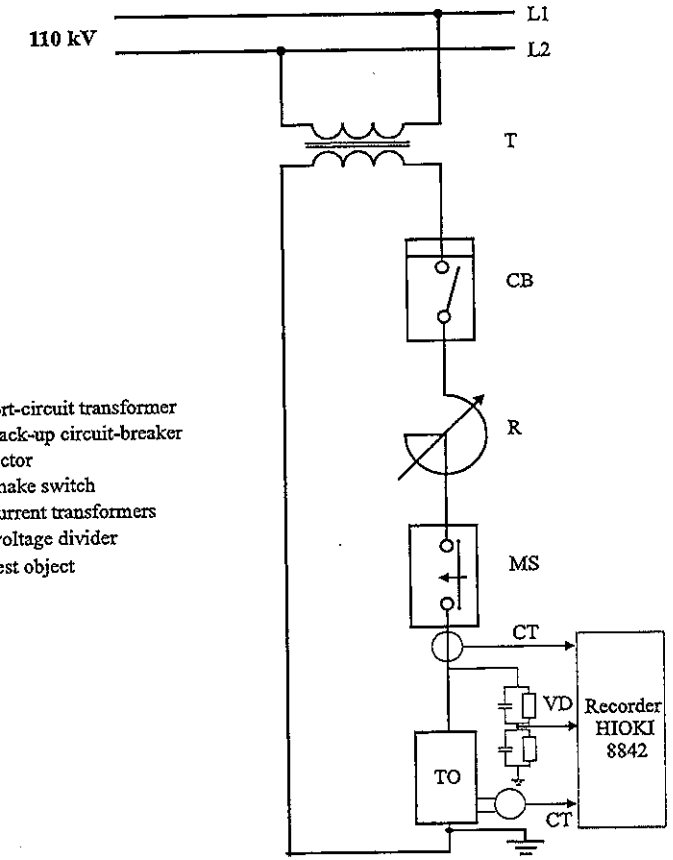
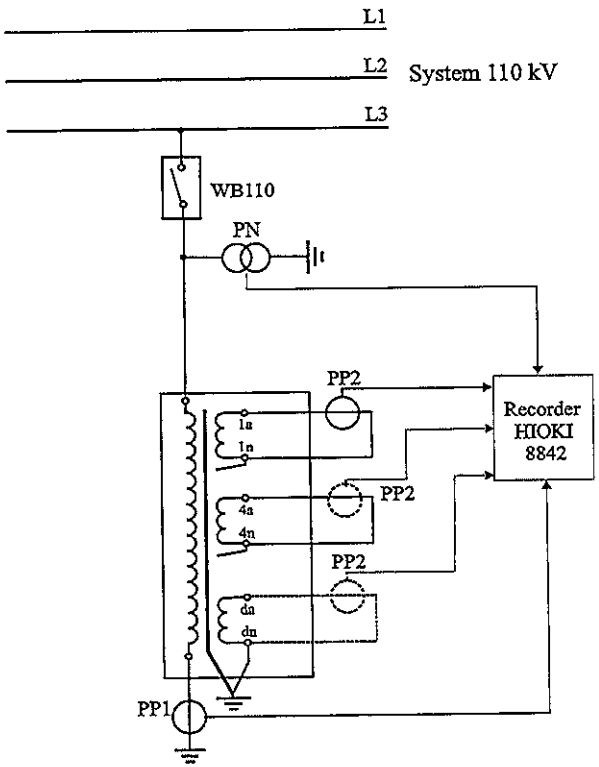


Fig. 1. Configuration of test circuit during tests during short-time current tests



ort-circuit transformer
back-up circuit-breaker
ctor
nake switch
urrent transformers
voltage divider
est object

Fig. 2. Test and measuring circuits during short-time current tests



WB110 - back-up circuit-breaker
PN - voltage transformer
PP1, PP2 - current transformers

Fig. 3. Test and measuring circuits during short-circuit withstand capability tests

AND THEIRS DETAILED RESULTS

esults presents tables 1, 2 and 3.
the tests the following records were made:
- Nos. 33089, 33090, 33092, 33093 – short-time current tests,
- No. 33095 – composite error test,
- No. 33096, 33097, 33098 – short-circuit withstand capability test,
(Annex 1 presents the copies of short-circuit test records - all records are stored in laboratory's archives),
- phot. 1, 2 – current transformer on the tests stand
(Annex 2 presents the photograph).

ts of short-time current tests

I_z	t_z	$I_z^2 \times t_z$	$I_{1S1\text{-}1S2}$	$I_{3S1\text{-}3S2}$	$I_{4S1\text{-}4S2}$	U_0	Observations
kA	s	$(kA)^2 \times s$	A	A	A	V	-
4,74	0,97	4066[2)]	256*	1517*	649	38	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
4,74	0,06	–	–	–	–	–	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
0,54	0,08	–	–	–	–	–	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
0,54	1,02	1676[4)]	269*	1556*	811	60	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

of test current,
e of test current (determined from test period without asymmetrical component),
n,
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component).
≥ 158 kA,
$_z \geq 3969\ (kA)^2 \times s$,
≥ 100 kA,
$_z \geq 1600\ (kA)^2 \times s$.
ed.

During the composite error test current's transformer burden connected to 4S1-4S2 was 2,4 Ω.

Table 2. Results of composite error test for 4S1-4S2 winding

Test No.	I_p	ε_c	t_z	Observations
-	kA	%	s	-
33095	4,31	0,98	1,02	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

Legend:
I_p – r.m.s. value of the test current (determined from test period without asymmetrical component),
t_z – test duration,

$$\varepsilon_c = \frac{\sqrt{\frac{1}{T}\int_0^T (k_r \cdot i_s - i_p)^2\, dt}}{I_p} \cdot 100\%$$

k_r – rated transformation ratio (50/1 A/A),
i_p – instantaneous value of the primary current,
i_s – instantaneous value of the secondary current,
T – duration of one cycle.

Table 3. Results of short-circuit withstand capability tests

Test No.	Terminals	U_z	I_{PS}	I_{SS}	t_z	Observations
-	-	kV	A	A	s	-
33096	1a – 1n	65,0[1)]	0,73	804	1,00	Behaviour of transformer during the tests was correct. After tests no damage nor oil leak was stated.
33097	4a – 4n	65,0[1)]	0,72	796	1,00	Behaviour of transformer during the tests was correct. After tests no damage nor oil leak was stated.
33098	da - dn	65,0[1)]	0,42	795	1,00	Behaviour of transformer during the tests was correct. After tests no damage nor oil leak was stated.

Legend:
U_z - test voltage
I_{PS} - r.m.s. value of primary side test current
I_{SS} - r.m.s. value of secondary side test current
t_z - test duration
1) - required $U_z \geq 63,5$ kV

5. TESTS RESULTS EVALUATION

According to criteria given in IEC 61869-2:2012 and IEC 61869-3:2011 the results of tests is positive for:

Test records

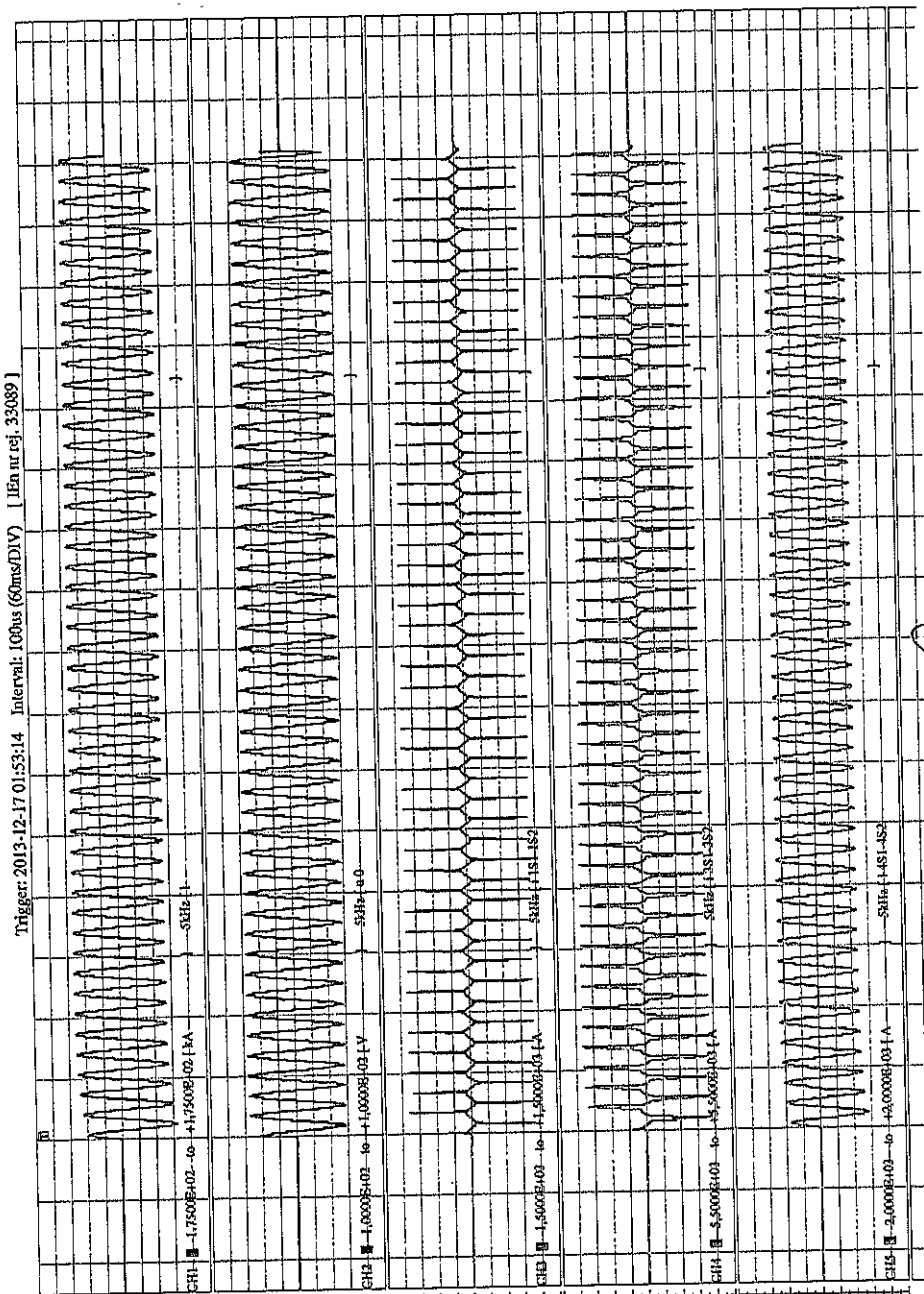
s not numbered pages the following copies of records are given:

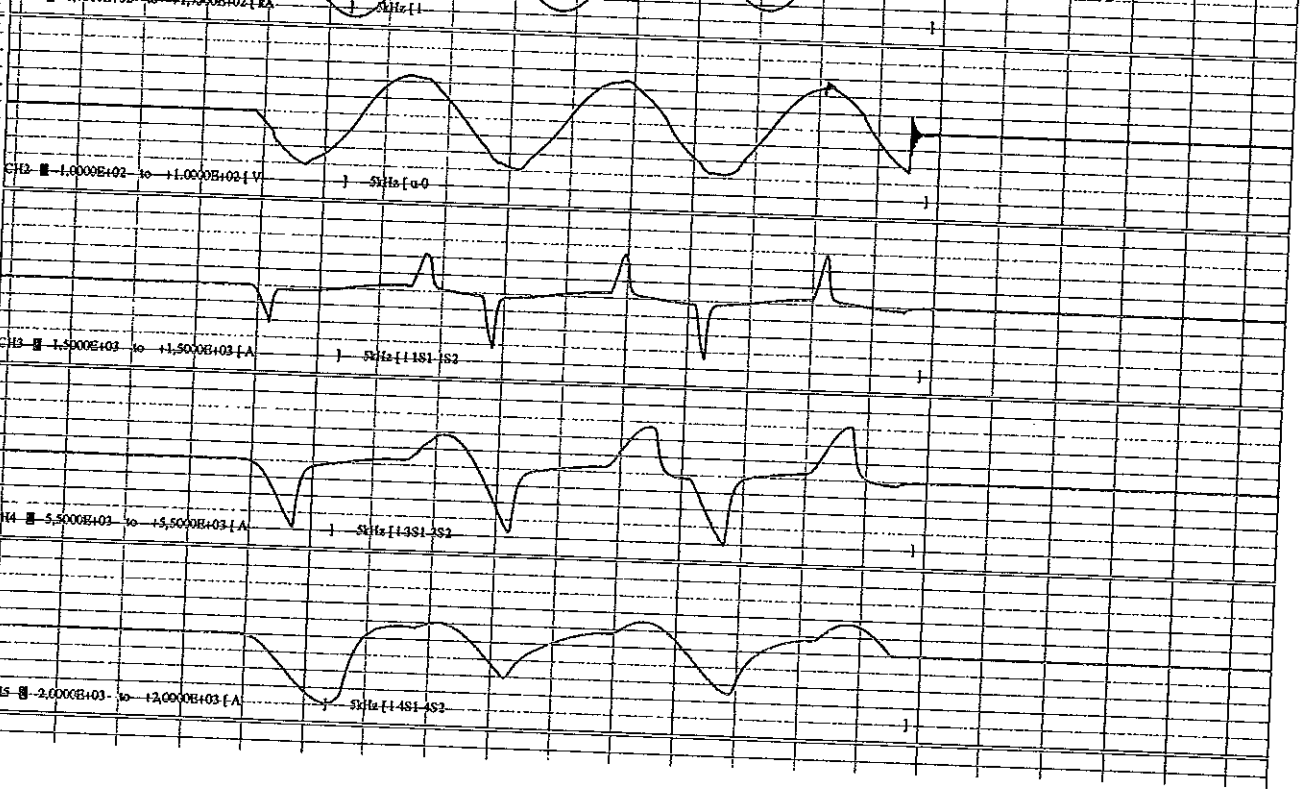
33089, 33090, 33092, 33093 – short-time current tests,
33095 – composite error test,
33096, 33097, 33098 – short circuit withstand capability test.

s:

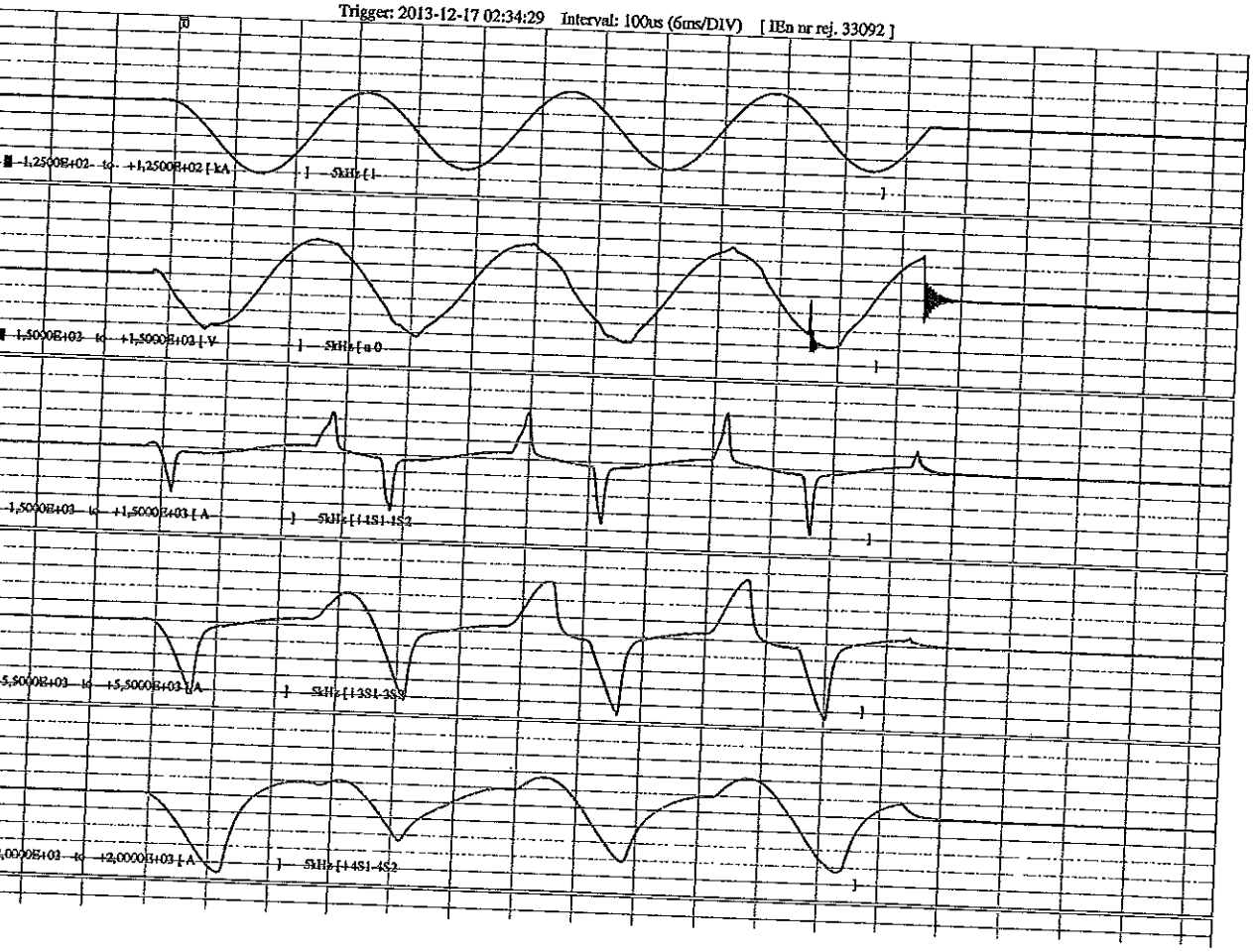
on test object,
winding current,
winding current,
winding current.

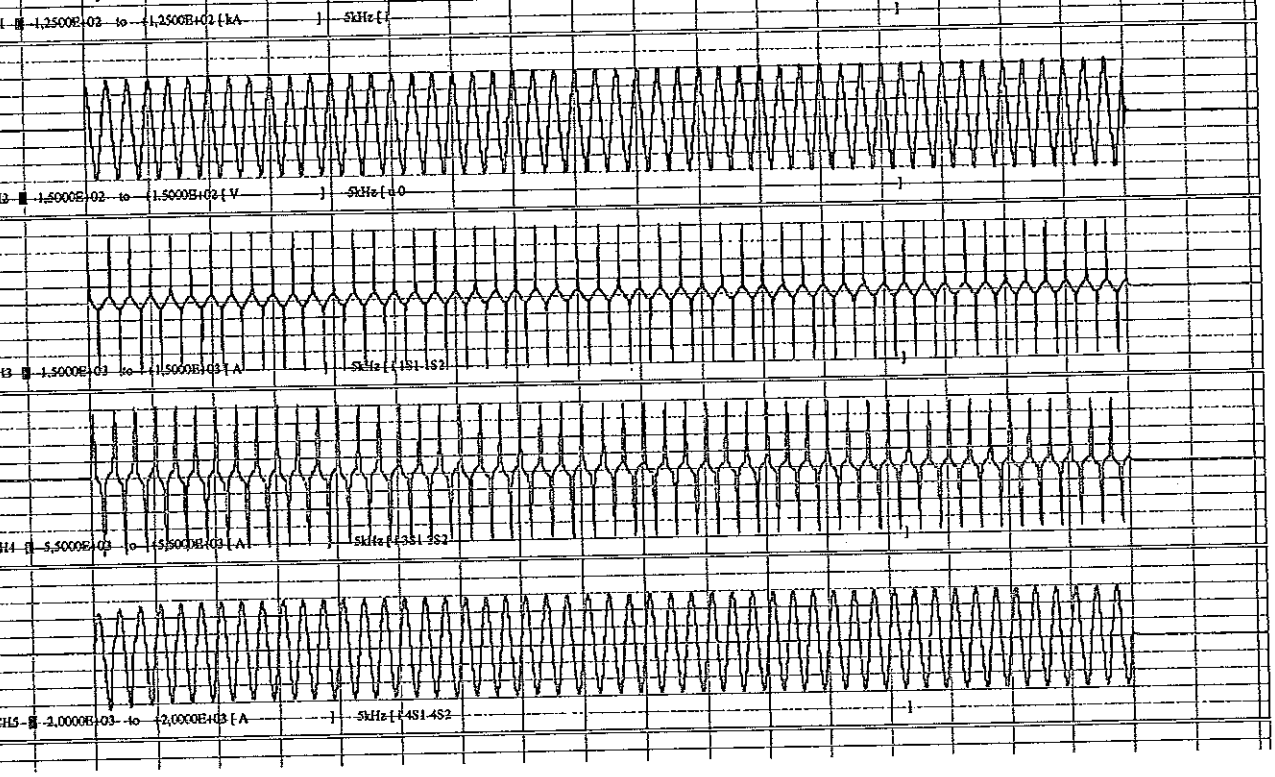
ering voltage transformer tests,
n primary side of VT,
- test current on secondary side of VT.



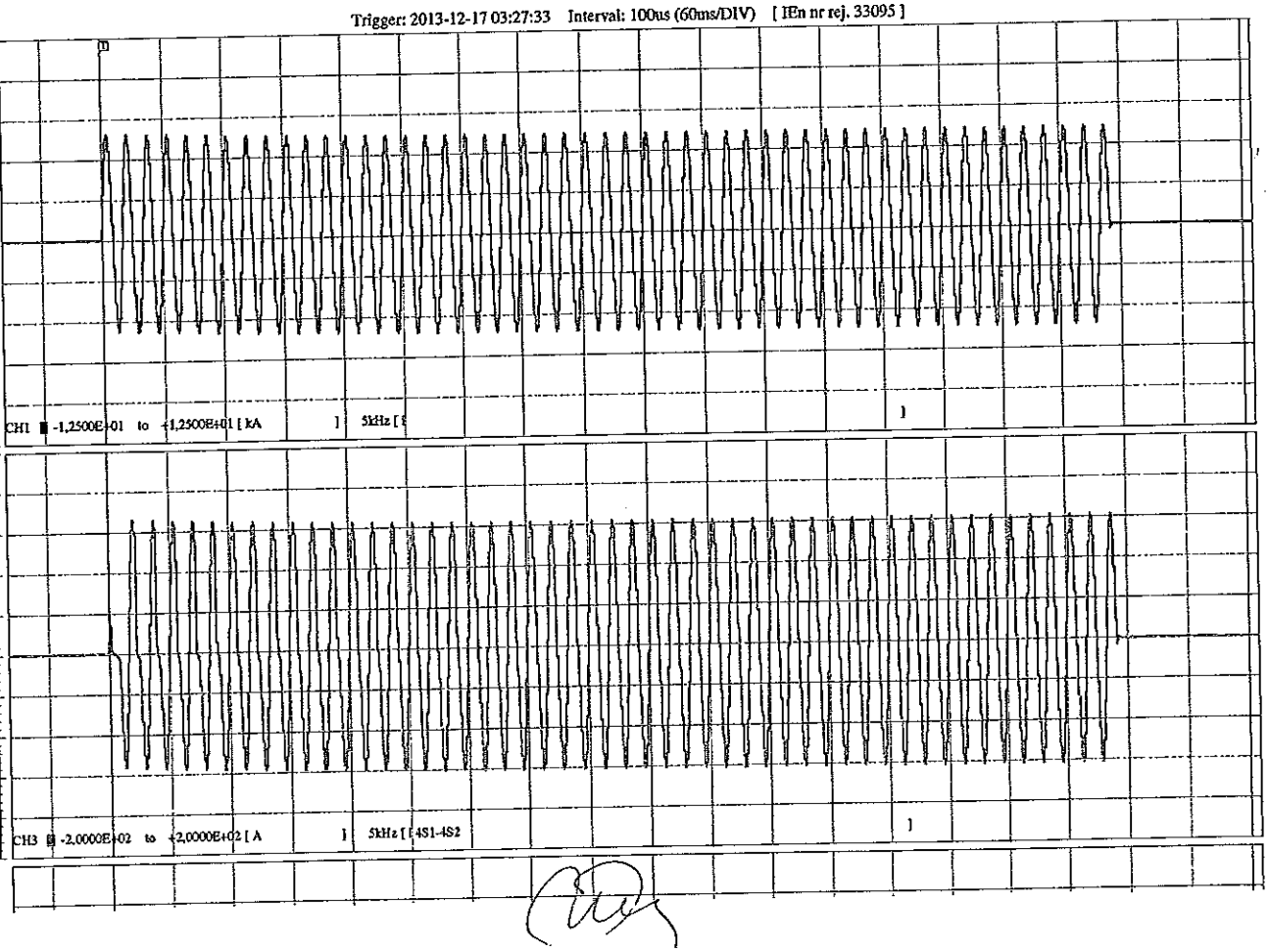


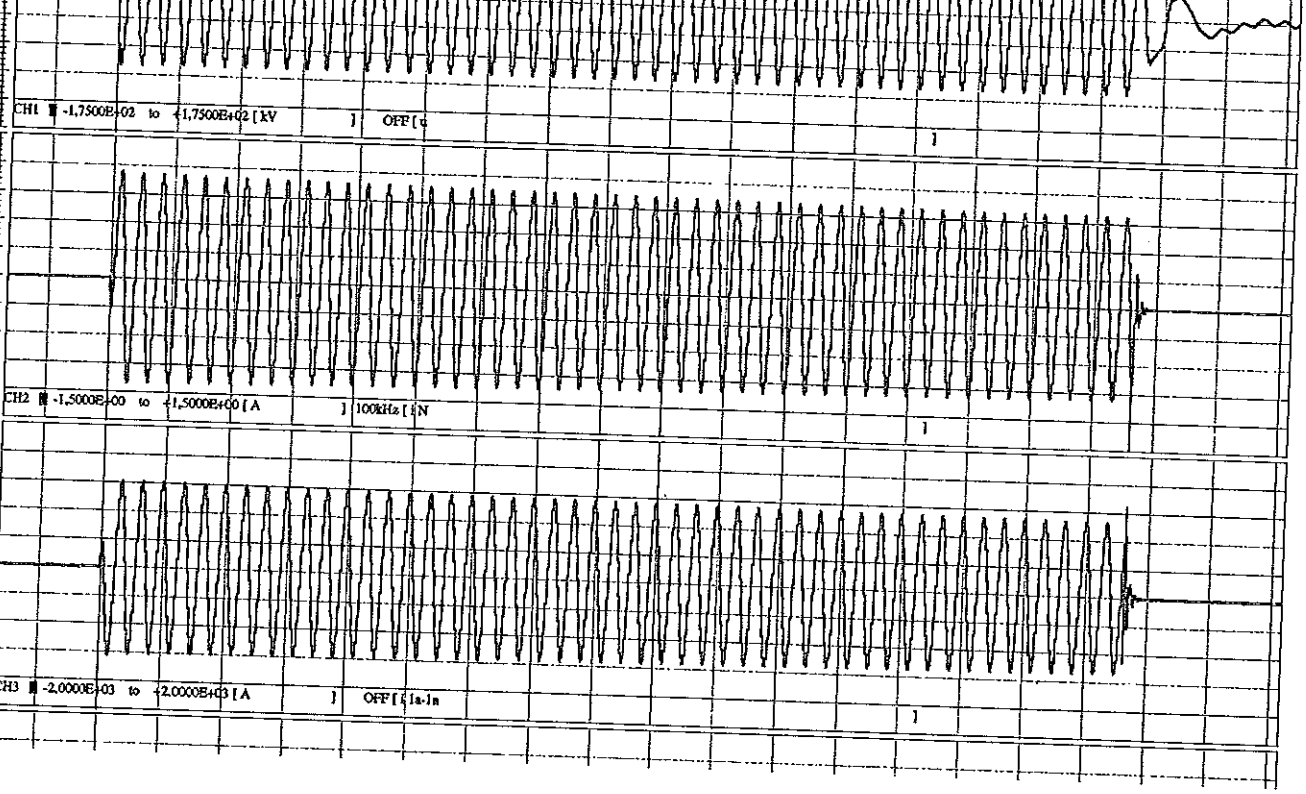
Trigger: 2013-12-17 02:34:29 Interval: 100us (6ms/DIV) [IEn nr rej. 33092]

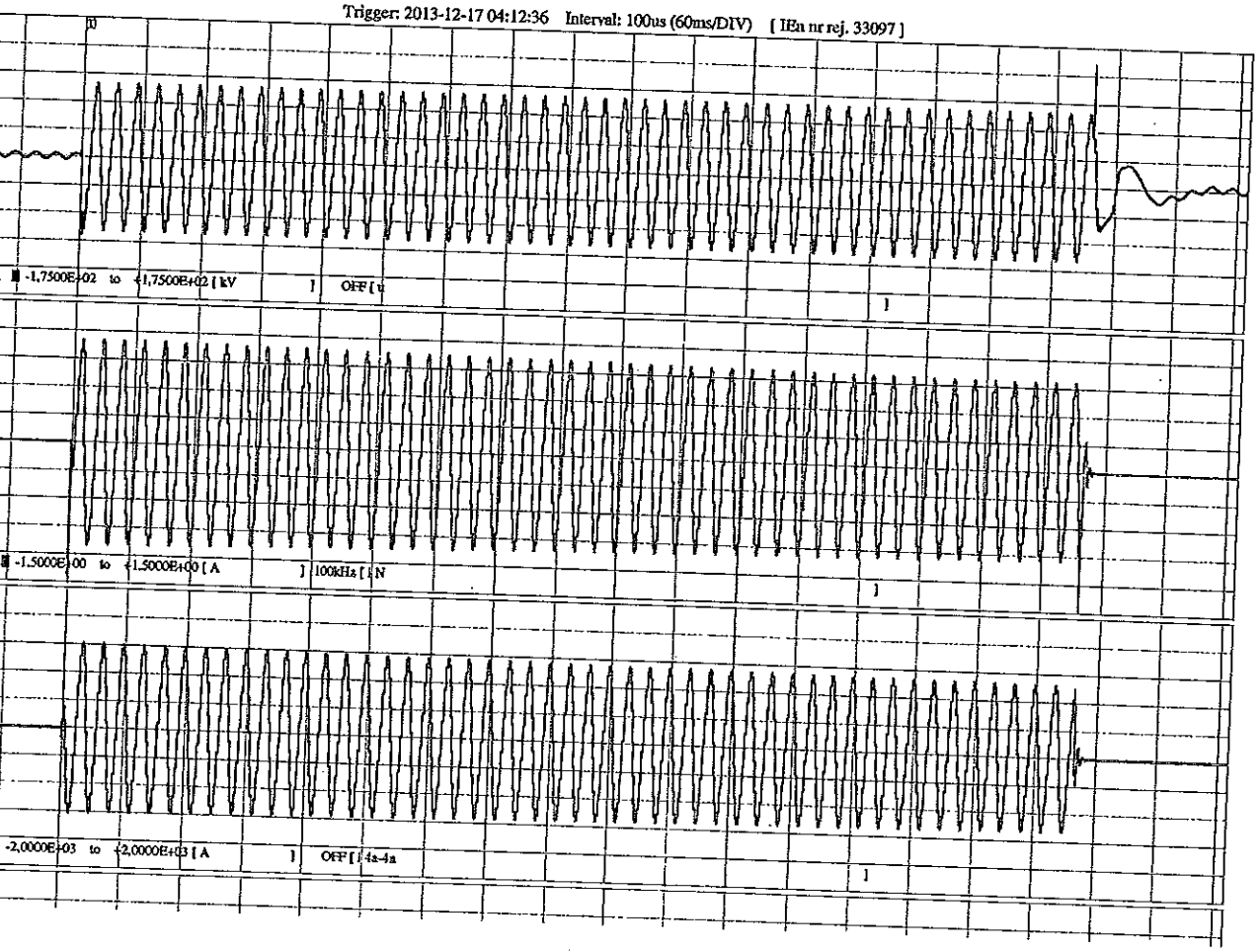


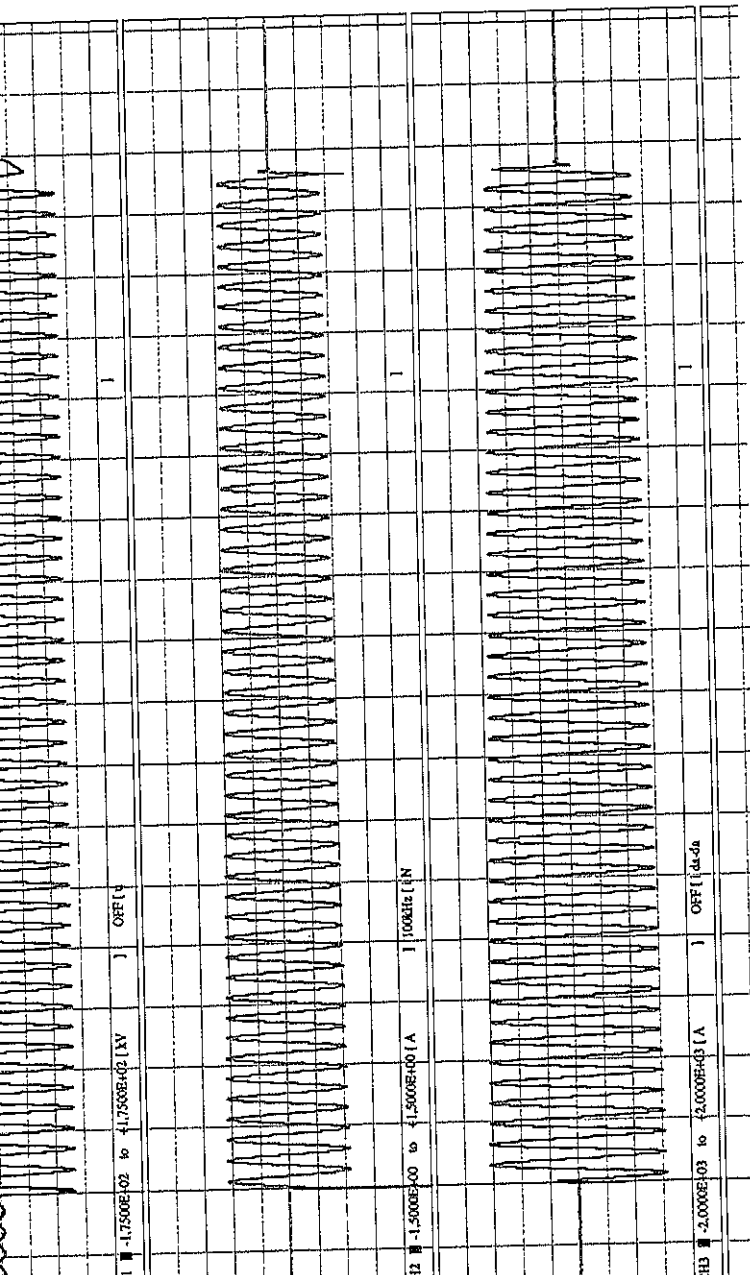


Trigger: 2013-12-17 03:27:33 Interval: 100us (60ms/DIV) [IEn nr rej. 33095]

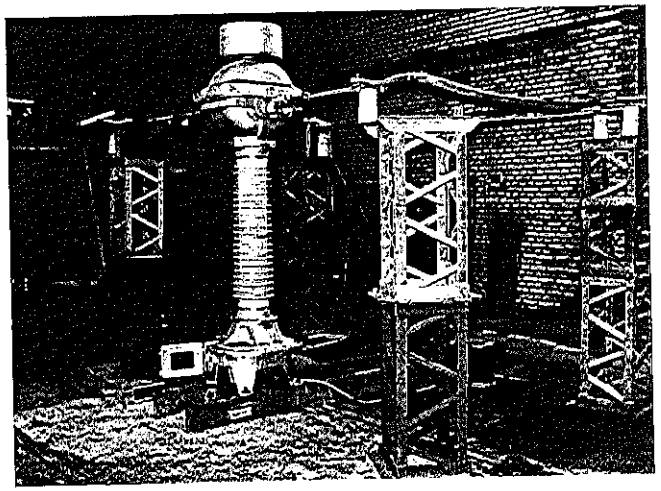



CH1 -1,7500E+02 to +1,7500E+02 [kV] OFF [u
CH2 -1,5000E+00 to +1,5000E+00 [A] 100kHz [N
CH3 -2,0000E+03 to +2,0000E+03 [A] OFF [1a-1n

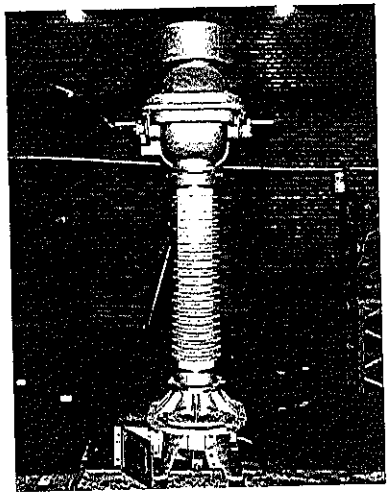

Trigger: 2013-12-17 04:12:36 Interval: 100us (60ms/DIV) [IEn nr rej. 33097]
-1,7500E+02 to +1,7500E+02 [kV] OFF [u
-1,5000E+00 to +1,5000E+00 [A] 100kHz [N
-2,0000E+03 to +2,0000E+03 [A] OFF [4a-4n



ANNEX 2 **Photographs taken during the tests**



Phot. 1. PVA 123a after short-time current tests



Phot. 2. PVA 123a after short circuit withstand capability test.

Routine test report before and after short-time current tests

sp. z o.o. Przasnysz szno 59	Routine tests report of combined instrument transformer			TYP: PVA123a Nr fabr. 2GKP013K1486138	
Insulation level: 126/230/550 kV	Voltage factor: 1,8 /8h	Ith 1 s [kA] 40-40-40	Idyn [kA] 100-100-100	Idh [A]: 180-360-720	IEC 61869-4 50 Hz

RT	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a-1n	0,1:√3	25	0,1	1000
		0,1:√3	25	3,0	1000
	2a-2n	0,1:√3	25	0,1	1000
		0,1:√3	25	3,0	1000
	3a-3n	0,1:√3	25	0,1/3P	1000
		0,1:√3	500	3/3P	1000
	4a-4n	0,1:√3	25	0,1/3P	1000
		0,1:√3	25	3/3P	1000
	da-dn	0,1: 3	100	1	450
		0,1: 3	300	3P	450

T	Winding	Isn [A]	Sn [VA]	class	Przekładnia [A/A]
	1S1-1S2	5	1->5	0,5FS5	50-10-200/5
	2S1-2S2	1	1->2,5	0,5FS10	50-10-200/1
	3S1-3S2	5	10	5P 10	50-10-200/5
	4S1-4S2	1	2,5	5P60	50-10-200/1
		1		PX Ek=190V Ie<=0,1A/95 V Rct<=0,3Ω Rb=3,5 Ω Kx=50 4-2-1/200	50-10-200/1
		1		TPX Kssc= 13 Ktd= 14,6 cykl = 0,1s Tp= 0,05 Rct<=0,3Ω Rb=1 Ω Ratio error <=0,5%	50-10-200/1
	5S1-5S2	1	5	5P10	50-10-200/1

tests

ameters check before filling (oil after	☑
7, breakdown voltage acc. IEC 60156	☑
minal	☑
ntness test: oil overpressure: 0,8 bar / 24h – no traces of oil	☑
withstand on primary windings	
– P1÷P2/A;Up=230 kV / 60 s,f =97 Hz; N; Up = 3 kV/ 60s, f=50 Hz	☑
withstand test on secondary – Up = 3 kV/60 s	☑
age test for current transformers– lower value (U szczyt. = 4,5 kV lub U szczyt. Przy Icth) / 60s	☑
errors	☑
he over current factors: FS, ALF	☑
apacitance and dielectric dissipation factor (tgδ)	☑
ore magnetization characteristics	☑
indings' resistance	☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tgδ according to IEC 60247
  Tgδ = 0,06%; electrical stress = 1 kV/mm, f=50 Hz, Oil temp. = 90°C±1°C

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage =77,42 kV, Relative standard deviation = 5,64%; f=50 Hz, oil temp. = 26 °C, measurement with the stirrer, type of electrodes used: partially spherical.

Sample	Breakdown voltage [kV]
1	83.2
2	80.1
3	70.8
4	79.2
5	76.4
6	74.8

Partial discharge measurement

- Measurement according to procedure A (PD test voltages were reached while decreasing the voltage after the power-frequency withstand test on primary winding)
Stress voltage 230 kV / 60 s
Frequency 97 Hz

Test voltage	1,2 Um = 151 kV	1,2 Um / √3 = 87,5 kV
Level of partial discharge	2 pC	1,5 pC

Remarks: background noise level: 1 (measured after voltage switch off), measuring circuit was calibrated with 5 pC (calibrating charge).

Inter-turn overvoltage test for current transformers

	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
1S1-1S2	0.088	400
2S1-2S2	0.307	400
3S1-3S2	0.205	400
4S1-4S2	1.41	400
5S1-5S2	0.736	400

nation of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

	Usn [kV]	Sn [VA]	klasa	Sth [VA]
	0,1:√3	25	0,1	1000
	0,1:√3	25	0,1	1000
	0,1:√3	25	0,1/3P	1000
	0,1:√3	25	3/3P	1000
	0,1: 3	100	3P	450

cos fi = 0,8 ind.

n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,035	-0,035	
Δφ U	2,2	2,3	

cos fi = 0,8 ind.

n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	k_t U_n
ε U	0,005	0,005	
Δφ U	2,1	2,2	

cos fi = 0,8 ind.

3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,025	-0,025	
Δφ U	2,3	2,4	

cos fi = 0,8 ind.

n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	k_t U_n
ε U	0,014	0,015	
Δφ U	2,2	2,2	

cos fi = 0,8 ind.

n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,020	-0,018	-0,017	-0,117
Δφ U	2,4	2,5	2,5	1,1

cos fi = 0,8 ind.

n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	0,019	0,021	0,021	-0,075
Δφ U	2,2	2,2	2,3	0,9

cos fi = 0,8 ind.

n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,024	-0,023	-0,023	-0,122
Δφ U	2,8	2,8	2,8	1,4

cos fi = 0,8 ind.

n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	0,021	0,023	0,023	-0,077
Δφ U	2,4	2,4	2,4	1,0

; cos fi = 0,8 ind.

25VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	1,0 U_n	1,2 U_n
ε U	-0,739	-0,738
Δφ U	8,9	9,0

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,035	0,037	0,037
Δφ U	3,6	3,6	3,6

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,075	0,077	0,077
Δφ U	3,4	3,5	3,5

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,044	0,046	0,047
Δφ U	3,7	3,7	3,8

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,084	0,086	0,086
Δφ U	3,5	3,5	3,6

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,094	-0,037	0,050	0,052	0,053	-0,046
Δφ U	-1,4	1,7	3,7	3,8	3,8	2,5

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,054	0,003	0,090	0,092	0,092	-0,007
Δφ U	-1,6	1,4	3,6	3,6	3,6	2,3

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,101	-0,041	0,045	0,047	0,047	-0,052
Δφ U	-1,2	1,9	4,0	4,0	4,1	2,7

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,054	0,002	0,090	0,092	0,092	-0,007
Δφ U	-1,4	1,5	3,6	3,6	3,7	2,4

da – dn 25 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA,

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	-0,304	-0,302	-0,302
Δφ U	5,2	5,2	5,3

9 Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

Determination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

Uzwojenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
1a-1n	0,1:√3	25	3,0	1000
2a-2n	0,1:√3	25	3,0	1000
3a-3n	0,1:√3	500	3/3P	1000
4a-4n	0,1:√3	25	3/3P	1000
da-dn	0,1: 3	300	3P	450

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,517	-0,515	-0,516	
Δφ U	-7,1	-7,1	-7,0	

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,478	-0,476	-0,475	
Δφ U	-7,2	-7,2	-7,1	

2a – 2n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA, cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,511	-0,509	-0,509	
Δφ U	-7,1	-7,1	-7,0	

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,470	-0,470	-0,469	
Δφ U	-7,3	-7,3	-7,2	

3a – 3n 500 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-1,151	-1,089	-0,996	-0,995	-0,993	-1,245
Δφ U	1,9	4,9	7,2	7,3	7,3	2,7

3a – 3n 125 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,383	-0,318	-0,230	-0,228	-0,227	-0,478
Δφ U	-1,9	1,2	3,5	3,5	3,6	-1,1

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,595	-0,537	-0,446	-0,445	-0,443	-0,699
Δφ U	-10,7	-7,5	-5,1	-5,1	-5,1	-9,7

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,265	-0,203	-0,113	-0,112	-0,11	-0,367
Δφ U	-4,5	-1,2	1,1	1,1	1,1	-3,6

da – dn 300 VA; cos fi = 0,8 ind.
1a-1n 25VA; 2a-2n 25VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	1,0 U_n	1,9 U_n
ε U	-1,229	-1,172	-1,072	-1,089
Δφ U	-5,8	-2,4	0,7	0,9

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,035	0,037	0,037
Δφ U	3,6	3,6	3,6

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,075	0,077	0,077
Δφ U	3,5	3,5	3,5

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,045	0,046	0,047
Δφ U	3,7	3,7	3,8

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,084	0,086	0,086
Δφ U	3,5	3,5	3,6

3a – 3n 500 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-1,080	-1,019	-0,928	-0,924	-0,924	-1,175
Δφ U	3,3	6,3	8,5	8,5	8,7	4,1

3a – 3n 125 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,305	-0,247	-0,158	-0,156	-0,155	-0,407
Δφ U	-0,5	2,7	4,8	4,8	4,9	0,3

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,097	-0,040	0,047	0,049	-0,049	-0,205
Δφ U	-1,2	1,9	4,0	4,0	4,1	-0,6

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,053	0,007	0,091	0,093	0,094	-0,161
Δφ U	-1,5	1,5	3,6	3,7	3,7	-0,9

da – dn 75 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA,

	0,02 U_n	0,05 U_n	1,0 U_n	1,9 U_n
ε U	-0,731	-0,668	-0,572	-0,584
Δφ U	4,5	7,7	9,8	10,2

*) at 1,9 Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

lination of current part errors (ε I %), (Δφ I min),

: 50

S1-1S2 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
-0.432	-0.235	-0.018	0.127	0.264	0.299	0.314	0.328
19.5	7.5	-1.0	-3.1	15.8	8.9	4.9	3.4
2S1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
0.024	-0.011	0.132	0.194	0.252	0.251	0.283	0.316
33.2	23.1	7.4	4.3	19.3	11.6	5.5	4.6

	4S1-4S2	
.0 In		1,0 In
896	ε I	-0.394
3	Δφ I	14.4

0 In
709
.4

100

-1S2 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
05I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
.393	-0.277	0.007	0.132	0.294	0.303	0.314	0.329
7.7	9.3	-0.4	-3.3	13.3	8.9	4.9	3.3
2S1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
05I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
025	0.013	0.136	0.194	0.248	0.244	0.277	0.315
3.1	20.6	6.4	5.2	19.0	12.4	5.7	4.1

	4S1-4S2	
In		1,0 In
0	ε I	-0.402
	Δφ I	14.7

n
1

0

32 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
5I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
81	-0.280	0.010	0.013	0.084	0.282	0.305	0.270
7	9.6	-0.7	0.2	25.8	11.2	5.2	7.5
1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
I_n	0,2 I_n	1,0 I_n	2,0 I_n	0,05I_n	0,2 I_n	1,0 I_n	2,0 I_n
2	-0.002	0.132	0.192	0.237	0.257	0.281	0.313
	22.6	6.8	4.8	20.7	11.8	5.6	4.6

	4S1-4S2	
		1,0 In
	ε I	-0.393
	Δφ I	14.4

Current part: Measurements uncertainty: **ε I = ±0,045 %, Δφ I = ±2,3 min**
Voltage part: Measurements uncertainty: **ε U = ±0,044 %, Δφ U = ±2,2 min**

Determination of the over current factors:

- instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	E FS [V]	Condition	Assessment
1S1-1S2	2.5	4.32	6.22	$U < E_{FS}$	☑
2S1-2S2	1	9.63	31.35	$U < E_{FS}$	☑

- granicznego dokładności (ALF) – próba błędu złożonego ε_c rdzeni zabezpieczeniowych

Winding	E_{ALF} [V]	Ie [A]	ε_c [%]	Condition	Assessment
3S1-3S2	21.18	1.176	2.35	$\varepsilon_c < 5\%$	☑
4S1-4S2	220.64	0.124	0.16	$\varepsilon_c < 5\%$	☑
5S1-5S2	53.08	0.129	1.29	$\varepsilon_c < 5\%$	☑

Determination of parameters of class PX core 4S1-4S2:

Ipn (A)	50	100	200
Factor Kx	53.86	54.87	54.87
Turns ratio error [%]	-0.009	-0.003	0.002

Determination of parameters of class TPX core 4S1-4S2:

Ipn (A)	50	100	200
Factor Kssc	13.41	13.87	13.86
Factor Ktd	14.46	14.46	14.46
Current ratio error [%]	-0.232	-0.230	-0.235
Ts [s]	5.319	5.511	5.500
ε-peak [%]	2.36	1.57	1.55

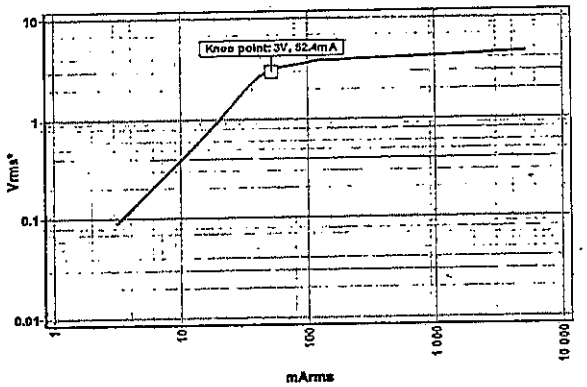
Measurement of capacitance and dielectric dissipation factor (tg δ)
Temperature: 22,3 °C, Frequency: 50 Hz

Primary voltage	Instrument transformer			Current part			Voltage part		
	Capacity	Capacity	Leak current	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current
	[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
10 kV	0.24	1383	4.36	0.25	1116	3.532	0.23	266	0.836
63 kV	0.24	1383	27.54	0.24	1116	22.21	0.22	266	5.297
71 kV	0.24	1383	30.9	0.24	1117	24.98	0.22	266	5.963

lization characteristics:

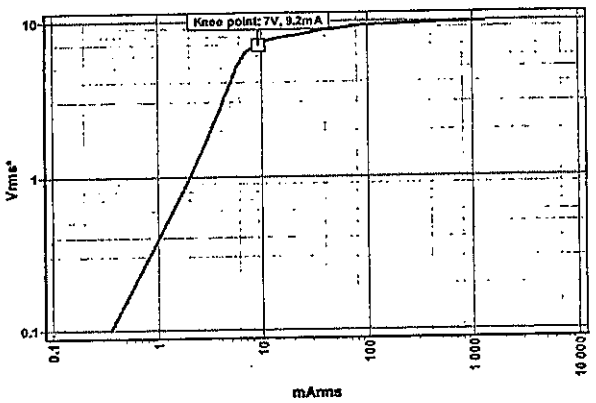
-1S2

[mA]
5292
2108.3
135.6
55.41
42.37
35
28.78
20.73
12.12
3.25



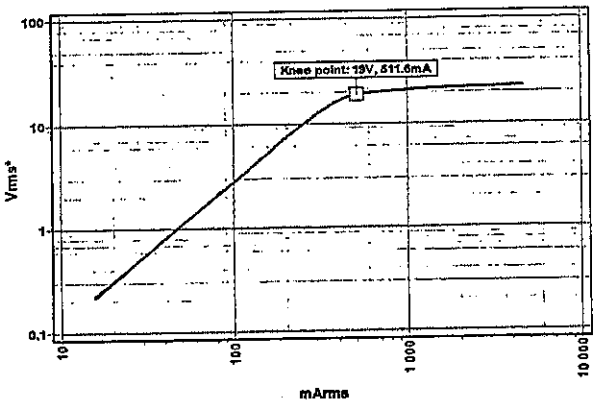
-2S2

mA]
24.3
13.6
3.1
6.71
4.58
.49
.87
.93
.19
.66
.75
.93
.85
.23
.32



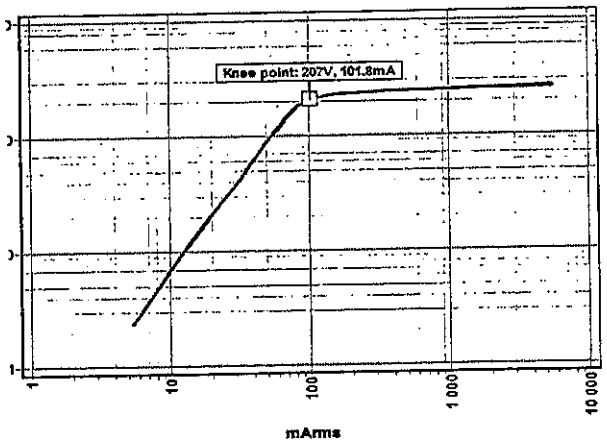
Winding 3S1-3S2

[V]	[mA]
22	2714.7
21.4	1328.1
20.6	814.6
19.2	555.1
17.8	444.8
16.5	398.7
15	358.4
13.8	329.9
12.3	297
10.9	268.9
9.6	243.4
8.7	186.1
4.1	130.9
1.2	51.58
0.2	13.46

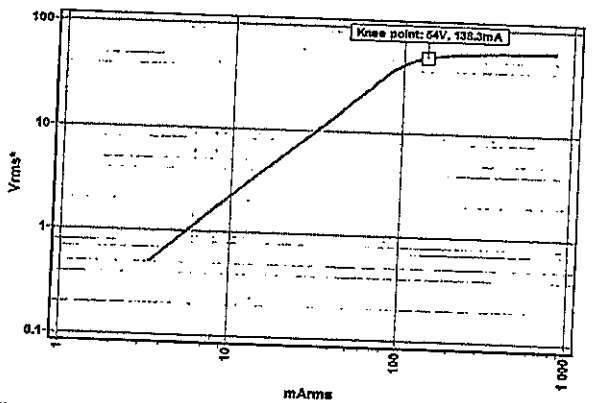


Winding 4S1-4S2

[V]	[mA]
256.5	5777
251.1	1957.8
248.2	1141.9
241.4	449.8
234	217
229.3	168.1
220.6	123.9
207.3	100.74
194.2	90.53
178.1	81.76
152.6	72.53
109.8	58.59
67.7	43.23
25.2	23
1.8	4.79



S1-5S2 [mA]
117.4
669.9
267.2
204.4
69.8
156
27.3
14.1
5.77
7.24
3.18
6.3
0.21
0.51
.51



ment of windings' resistance

' resistance of current part:

	R (23°C)	R ct (75°C)
range 50 A	266.0 µΩ	320.4 µΩ
ange 100 A	100.0 µΩ	120.4 µΩ
ange 200 A	47.0 µΩ	56.6 µΩ
1-1S2	0.048 Ω	0.058 Ω
1-2S2	0.527 Ω	0.635 Ω
1-3S2	0.024 Ω	0.029 Ω
1-4S2	0.214 Ω	0.257 Ω
1-5S2	0.315 Ω	0.380 Ω

resistance of voltage part:

	R (24,9°C)	R ct (75°C)
-N	17.30 kΩ	20.835 kΩ
-1n	44.120 mΩ	53.136 mΩ
-2n	45.150 mΩ	54.377 mΩ
-3n	46.680 mΩ	56.220 mΩ
-4n	48.050 mΩ	57.869 mΩ
-dn	31.900 mΩ	38.419 mΩ

OG-4
KJ-06

Przasnysz. 12.11.2013 r.

AEE Sp. z o.o. 06 – 300 Przasnysz ul. Leszno 59		Routine tests report of combined instrument transformer after short time current test			TYP: PVA123a Nr fabr. 2GKP013K1486138	
A – N 110:$\sqrt{3}$ kV	Insulation level: 126/230/550 kV	Voltage factor: 1,9 /8h	Ith 1 s [kA] 40-63-63	Idyn [kA] 100-158-158	Icth [A]: 100-200-400	IEC 61869-4 50 Hz

CZŁON NAPIĘCIOWY	Uzwojenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
	1a-1n	0,1:√3	25	0,1	1000
		0,1:√3	25	3,0	1000
	2a-2n	0,1:√3	25	0,1	1000
		0,1:√3	25	3,0	1000
	3a-3n	0,1:√3	25	0,1/3P	1000
		0,1:√3	500	3/3P	1000
	4a-4n	0,1:√3	25	0,1/3P	1000
		0,1:√3	25	3/3P	1000
	da-dn	0,1: 3	100	1	450
		0,1: 3	300	3P	450

CZŁON PRĄDOWY	Uzwojenie	Isn [A]	Sn [VA]	klasa	Przekładnia [A/A]
	1S1-1S2	5	1->5	0,5FS5	50-10-200/5
	2S1-2S2	1	1->2,5	0,5FS10	50-10-200/1
	3S1-3S2	5	10	5P 10	50-10-200/5
		1	2,5	5P80	50-10-200/1
	4S1-4S2	1		PX Ek = 190V Ie <= 0,1A/95 V Rct <= 0,3 Ω Rb = 3,5 Ω Kx = 50 4-2-1/200	50-10-200/1
		1		TPX Kssc = 13 Ktd = 14,6 cykl = 0,1s Tp = 0,05 Rct <= 0,3Ω Rb = 1 Ω Ratio error <= 0,5%	50-10-200/1
	5S1-5S2	1	5	5P10	50-10-200/1

List of performer tests

1. Oil dielectric parameters check before filling (oil after tgδ wg IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil ☑
4. Power-frequency withstand on primary windings – P1+P2/A;Up=230 kV / 60 s,f =97 Hz; N; Up = 3 kV/ 60s, f=50 Hz ☑
5. Partial discharge ☑
6. Power-frequency withstand test on secondary – Up = 3 kV/60 s ☑
7. Inter-turn overvoltage test for current transformers– lower value (U szczyt. = 4,5 kV lub U szczyt. Przy Icth) / 60s ☑
8. Determination of errors ☑
9. Determination of the over current factors: FS, ALF ☑
10. Measurement of capacitance and dielectric dissipation factor (tgδ) ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

parameters check before filling (oil after treatment)

t of oil tgδ according to IEC 60247
6%; electrical stress = 1 kV/mm, f=50 Hz, Oil temp. = 90°C±1°C

t of breakdown voltage according to IEC 60156
akdown voltage =77,42 kV, Relative standard deviation = 5,64%; f=50 Hz,
°C, measurement with the stirrer, type of electrodes used: partially spherical.

Napięcie przebicia [kV]
83.2
80.1
70.8
79.2
76.4
74.8

scharge measurement

ement according to procedure B
ltage 230 kV / 60 s
y 97 Hz

	1,2 Um = 151 kV	1,2 Um / √3 = 87,5 kV
al discharge	1.2 pC	1,2 pC

; background noise level: 1 (measured after voltage switch off),
g circuit was calibrated with 5 pC (calibrating charge).

n overvoltage test for current transformers

Winding	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
1S1-1S2	0.09	400
2S1-2S2	0.3	400
3S1-3S2	0.192	400
4S1-4S2	1.31	400
5S1-5S2	0.704	400

Determination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

Uzwojenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
1a-1n	0,1:√3	25	0,1	1000
2a-2n	0,1:√3	25	0,1	1000
3a-3n	0,1:√3	25	0,1/3P	1000
4a-4n	0,1:√3	25	3/3P	1000
da-dn	0,1: 3	100	1	450

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,036	-0,034	-0,034	
Δφ U	2.1	2.1	2.2	

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	0,003	0.005	0.005	
Δφ U	2.0	2.1	2.1	

2a – 2n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0.030	-0.028	-0.026	
Δφ U	2.3	2.3	2.3	

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	0.009	0.011	0.011	
Δφ U	2.1	2.1	2.2	

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.167	-0.107	-0.020	-0.018	-0.017	-0.117
Δφ U	-3.0	0.1	2.4	2.4	2.5	1.0

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.120	-0.065	0.020	0.022	0.022	-0.078
Δφ U	-3.2	-0.1	2.2	2.2	2.2	0.8

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0.176	-0.115	-0.028	-0.026	-0.026	-0.125
Δφ U	-2.7	0.5	2.7	2.8	2.8	1.4

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	k_t U_n
ε U	-0,122	-0.066	0.019	0.021	0.021	-0.079
Δφ U	-3.0	0.1	2.3	2.3	2.4	0.9

da – dn 100 VA; cos fi = 0,8 ind.
1a-1n 25VA; 2a-2n 25VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	-0.741	-0.738	-0.738
Δφ U	8.9	8.9	9.0

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,036	0.038	0.038
Δφ U	3.5	3.5	3.6

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.075	0.076	0.077
Δφ U	3.5	3.5	3.6

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.042	0.044	0.044
Δφ U	3.6	3.6	3.7

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.081	0.083	0.083
Δφ U	3.5	3.5	3.6

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.087	-0.035	0.053	0.054	0.055	-0.044
Δφ U	-1.5	1.6	3.7	3.7	3.8	2.5

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.052	0.006	0.082	0.084	0.094	-0.006
Δφ U	-1.7	1.4	3.5	3.5	3.6	2.3

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.111	-0.048	0.035	0.038	0.039	-0.055
Δφ U	-1.3	1.8	4.0	4.0	4.0	2.7

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.058	0.002	0.067	0.069	0.069	-0.008
Δφ U	-1.7	1.5	3.8	3.8	3.7	2.3

da – dn 25 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA,

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	-0.304	-0.302	-0.302
Δφ U	5.2	5.2	5.3

*) at 1,9 Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

nation of current part errors (ε I %), (Δφ I min),

50

1S1-1S2 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
0,05In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
-0.383	-0.232	-0.025	0.132	0.295	0.300	0.315	0.333
17.3	7.5	-1.1	-3.3	13.2	8.8	4.9	3.1
2S1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
0,05In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
0.035	0.008	0.138	0.193	0.254	0.241	0.276	0.321
32.6	22.0	7.0	3.9	18.7	12.7	5.8	3.1

	4S1-4S2
0 In	1,0 In
.935	ε I -0.391
4	Δφ I 14.6

0 In
701
.5

00

1S1-1S2 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
05In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
.743	-0.243	0.021	0.132	0.129	0.305	0.317	0.334
7.0	8.3	-0.8	-3.3	29.3	8.9	4.9	3.1
2S1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
05In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
027	0.009	0.137	0.191	0.251	0.237	0.272	0.319
2.6	22.5	7.1	4.0	19.0	13.6	6.1	3.0

	4S1-4S2
In	1,0 In
12	ε I -0.391
	Δφ I 14.5

In
7

S2 5 VA; cosφ = 0,8				1S1-1S2 1 VA; cosφ = 0,8			
5In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
93	-0.316	-0.083	0.068	0.158	0.277	0.280	0.294
6	11.4	2.9	-1.4	21.6	12.4	7.8	6.3
1-2S2 2.5 VA; cosφ = 1				2S1-2S2 1 VA; cosφ = 1			
In	0,2 In	1,0 In	2,0 In	0,05In	0,2 In	1,0 In	2,0 In
3	0.039	0.143	0.194	0.249	0.251	0.279	0.321
8	19.1	6.4	4.0	19.0	12.4	5.7	3.3

	4S1-4S2
	1,0 In
	ε I -0.392
	Δφ I 14.5

Current part: Measurements uncertainty: **ε I = ±0,045 %, Δφ I = ±2,3 min**
Voltage part: Measurements uncertainty: **ε U = ±0,044 %, Δφ U = ±2,2 min**

Determination of the over current factors:

- instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	E_{FS} [V]	Condition	Assessment
1S1-1S2	2.5	4.29	6.22	$U < E_{FS}$	☑
2S1-2S2	1	9.64	31.28	$U < E_{FS}$	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Winding	E_{ALF} [V]	Ie [A]	ε_c [%]	Warunek	Assessment
3S1-3S2	21.14	1.156	2.31	ε_c < 5%	☑
4S1-4S2	220.32	0.127	0.16	ε_c < 5%	☑
5S1-5S2	53.95	0.129	1.29	ε_c < 5%	☑

Determination of parametors of class PX core 4S1-4S2:

Ipn (A)	50	100	200
Factor Kx	54.93	54.94	54.94
Turns ratio error [%]	-0.007	-0.003	0.002

Determination of parameters of class TPX core 4S1-4S2:

Ipn (A)	50	100	200
Factor Ksac	13.91	13.91	13.92
Factor Ktd	14.46	14.46	14.46
Current ratio error [%]	-0.225	-0.230	-0.235
Ts [s]	5.498	5.517	5.500
ε-peak [%]	1.530	1.528	1.530

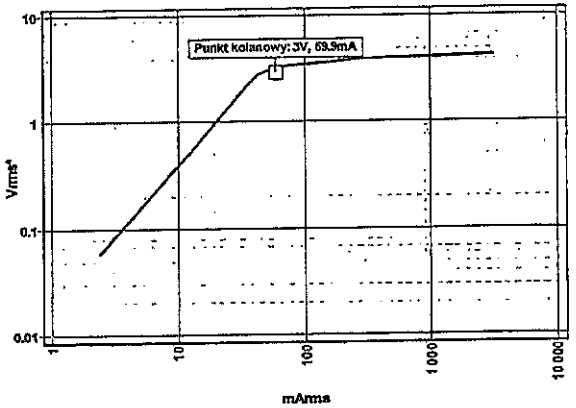
Measurement of capacitance and dielectric dissipation factor (tg δ)
Temperature: 22,3 °C, Frequency: 50 Hz

Primary voltage	Instrument transformer			Current part			Voltage part		
	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current
	[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
10 kV	0.23	1378	4.32	0.24	1111	3.459	0.22	266	0.833
63 kV	0.23	1378	27.22	0.24	1112	21.93	0.22	266	5.252
71 kV	0.23	1378	30.77	0.24	1112	24.82	0.22	266	5.939

ization characteristics:

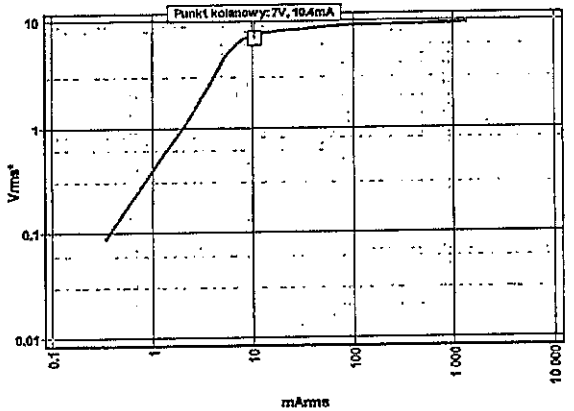
-1S2

[mA]
3146.5
261.1
61.75
43.85
35.91
28.93
20.93
12.27
2.41



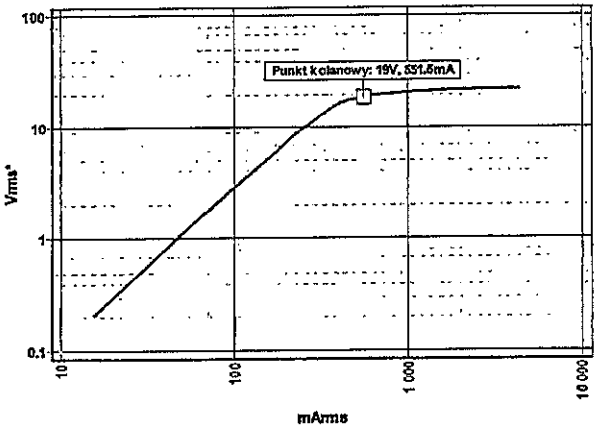
2S2

mA]
371.9
96.7
7.91
7.12
8.63
1.18
8.3
7.18
6.44
5.79
4.92
3.98
2.9
1.28
0.34



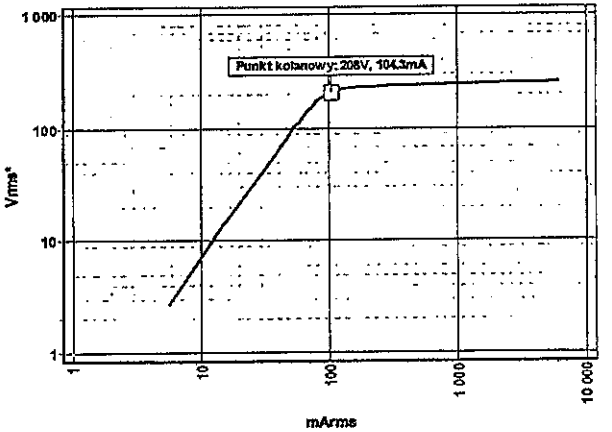
Winding 3S1-3S2

[V]	[mA]
22.4	4318.6
21.9	2020.1
21.0	1039.6
19.8	607.5
18.2	472.7
16.9	411.5
15.3	366.6
14.0	333.9
12.7	305.3
11.3	276.6
9.7	245.5
7.0	192.1
4.0	128.2
1.3	55.24
0.2	15.55

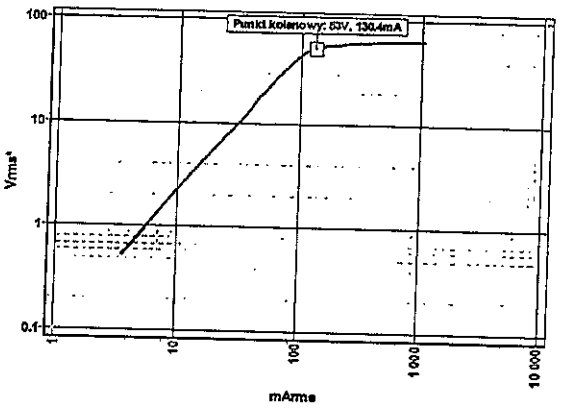


Winding 4S1-4S2

[V]	[mA]
256.9	6035
252.7	2439.3
248.4	1129.5
243.5	554.3
228.8	165.1
223.8	137.5
215.6	113.2
202.1	97.48
185.6	85.34
171.9	78.69
158.4	73.91
114.0	58.23
70.8	42.85
26.9	23.1
2.7	5.8



1-5S2 [mA]
044.4
543.6
257.6
183.6
159.5
141.4
121.5
109.27
101.74
98.35
92.16
86.64
79.95
69.35
3.56



ment of windings' resistance

resistance of current part:

	R (23°C)	R ct (75°C)
range 50 A	278.0 µΩ	333.7 µΩ
range 100 A	119.0 µΩ	142.9 µΩ
range 200 A	66.0 µΩ	79.2 µΩ
1-1S2	0.048 Ω	0.057 Ω
1-2S2	0.523 Ω	0.628 Ω
1-3S2	0.023 Ω	0.028 Ω
1-4S2	0.212 Ω	0.254 Ω
1-5S2	0.313 Ω	0.376 Ω

nce of voltage part:

	R (23°C)	R ct (75°C)
-N	17.30 kΩ	20.767 kΩ
-1n	44.060 mΩ	52.891 mΩ
-2n	44.960 mΩ	53.971 mΩ
-3n	46.460 mΩ	55.772 mΩ
-4n	47.940 mΩ	57.549 mΩ
-dn	31.600 mΩ	37.934 mΩ

OG-4 KJ-06

Przasnysz. 24.01.2014 r.

ANNEX 4 **Documentations delivered by orderer**

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 001/2014 (EN)
(acc. to ISO/IEC 17050-1)

Manufacturer: ABB Sp. z o.o. Dept. in Przasnysz

Address: Str. Leszno 59
06-300 Przasnysz / POLAND

Product: Combined Instrument Transformer PVA 123a

Above mentioned product comforms with the following standard :

Standard	Title	Edition/Date
IEC 61869 - 4	Combined Instrument Transformers	2013

Additional information:
Serial numbers: **2GKP013K1486138;**

Place and date of issue of declaration

Przasnysz 13.01.2014

ABB
ABB Sp. z o.o.
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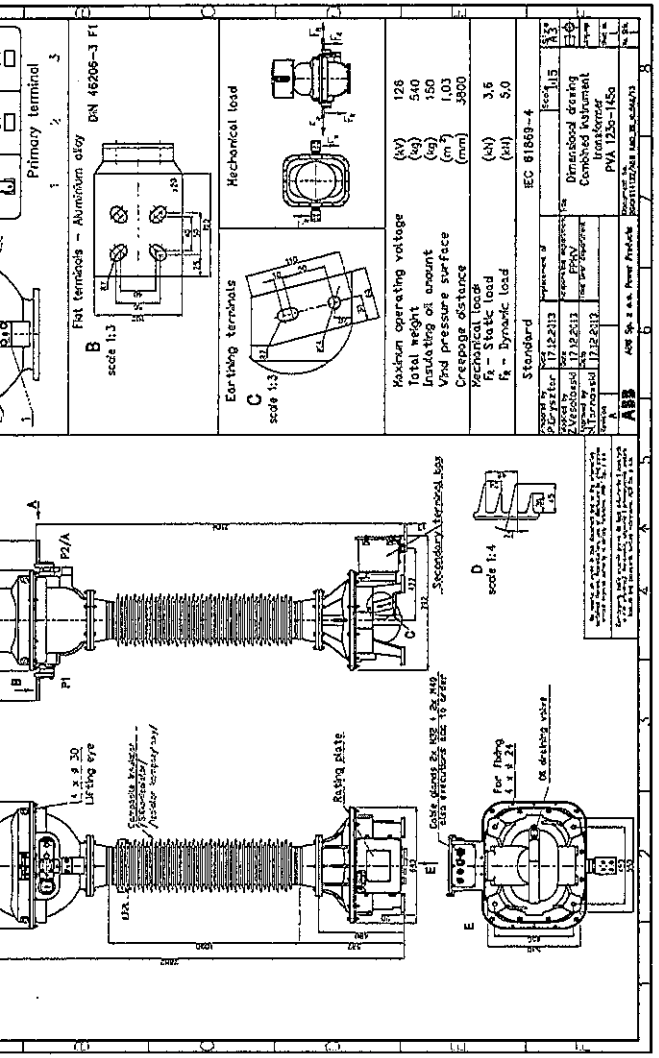
Referent ds. Regionali Zamówień
ABB Sp. z o.o.
Oddział w Przasnyszu
Małgorzata Łodzińska

Kierownik ds. Zapewnienia ...
ABB Sp. z o.o.
Oddział w Przasnyszu
Krzysztof Lubrow...

(Name) (Signature)



ABB

Combined Instrument Transformer

Type: PVA 123a

Insulation level	126/230/550 kV	Standard	IEC 61869-4	fn	50 Hz
Oil type	Nytro Libra	Weight / Oil weight	540 / 150 kg	Temp. range	-50°C ÷ +40°C
S/N	2GKP013K1486138	Voltage factor	1,9Un/8h	Ue	0,2 mV/kA

CURRENT PART

K_n 50-100-200 / 5-1-5-1-1 A/A

$I_{th}/1s$ 40 - 63 - 63 kA I_{dyn} 100 - 158 - 158 kA

I_{cth} 100 - 200 - 400 A

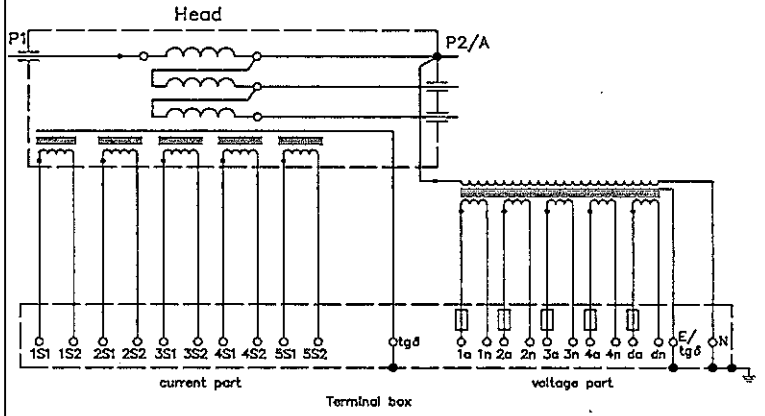
	A	VA	class	FS/ALF	Ext.%
1S1-1S2	5	1 -> 5	0,5	5	200
2S1-2S2	1	1 -> 2,5	0,5	10	200
3S1-3S2	5	10	5P	10	-
4S1-4S2	1	2,5	5P	80	-
		Rb=3,5Ω,class PX, 4-2-1/200, Ek=190 V, Ie<=0,1 A / 95 V, Rct<=0,3Ω, Kx=50			
		Rb=1Ω, classTPX 13x14,6, Rct <=0,3Ω , cykl 100 ms, Tp=50 ms			
5S1-5S2	1	5	5P	10	-
6S1-6S2					

VOLTAGE PART

A-N 110:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	100:√3	100:√3	100:√3	100:√3	100:3
VA	25	25	25	25	100
Klasse	0,1	0,1	0,1/3P	0,1/3P	1,0
VA	(25)	(25)	(500)	(25)	300)
Klasse	(3)	(3)	(3/3P)	(3/3P)	(3P)
VAext	1000	1000	1000	1000	450

Transportation: Vertical / Horizontal



Instrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 -- XS2
2. DURING INSTRUMENT TRANSFORMER OPERATION TERMINALS: N, E/tgδ, tgδ MUST BE EARTHED
3. AFTER THREE WINDINGS da - dn ARE CONNECTED IN BROKEN DELTA THE CIRCUIT SHOULD BE EARTHED IN ONE POINT ONLY

INSTITUTE OF POWER ENGINEERING
ISTRIBUTION EQUIPMENT LABORATORY

01-330 Warsaw, ul Mory 8
tel.fax. +48 22 836-73-35
tel. +48 22 345-13-86

TEST REPORT No. EUR/74/E/13 E

Combined instrument transformer type PVA 145a with porcelain insulator
Serial No. 2GKP013K1486140

ER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

D BY: Internal order No. EWN/145/E/13 dated 09.12.2013

S: Short-time current tests
Test for composite error

URE: According to IEC 61869-2:2012

S: 10/11.12.2013

: Positive for
$I_{dyn} = 158$ kA, $I_{th} = 63$ kA, t = 1 s for 1000 A terminal

Tests result refers only to the test object

ERE
Y: M. Tarnowski, Z. Wesołowski – ABB Sp. z o.o.

ineer

zmarczyk

HEAD OF LABORATORY

Lidia Gruza

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records (pages not numbered)	3
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figures	2
photographs	1

JECT

cription

ed instrument transformer type PVA 145a is used for supplying of measuring and its in the network of maximum operating voltage 132 kV and frequency 50 Hz. The sists of current and voltage transformers mounted in common housing with or immersed with transformer oil.

nical data

ufacturer attributed the following construction data to the test object.

ting voltage	132 kV
	50 Hz
s thermal current	1000 A, 2000 A
current for 1 s	63 kA
urrent	158 kA

nical documentation

e of tests the orderer delivered the following technical documentation:
wing combined transformer PVA 123a-145a, No. 2GKK614121 (17.12.2013),
ort of combined instrument transformer (12.11.2013),
ort of combined instrument transformer after short-time current test (20.12.2013),

former electrical diagram
Sp. z o.o (Annex 3 and 4).
oceeded the identification of test object on the base of above documentation and onformity of manufacturing with constructional documentation is stated declaration, copy of which presents Annex 4.

ration for tests

was prepared for tests in the factory by the manufacturer.

TESTS

greed with orderer, comprised the following tests according to requirements of :

nt tests of current transformer acc. to item 7.2.201 of above standard at

A, I_{th} = 63 kA, t_{th} = 1 s, $I_{th}^2 \times t_{th} \geq 3969$ kA^2×s for 1000 A terminal.

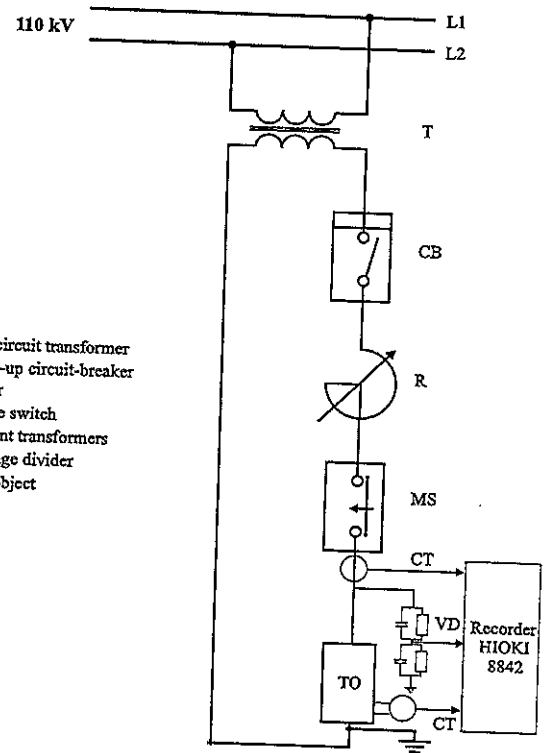
error acc. to item 7.2.6.203 of above standard with current's transformer burden nected to 6S1-6S2 windings at parameters:
kA, t_{th} = 1 s for 1000 A terminal,

and after short-time current test made in factory.

3. TEST AND MEASURING CIRCUITS

For the tests the transformer was fixed to the rigid construction of the test stand. Short-time current tests and test for composite error were made in one-phase circuit presented on fig. 1 at dimensions presented on fig.2.
The following quantities were recorded during the tests using digital recorder type HIOKI 8842:

- primary current (with short-circuited all secondary terminals) during short-time current tests using laboratory current transformer type CdC class 0,5 with a ratio 50.000/2 A/A (uncertainty of measurement ±0,018% for k = 2),
- secondary currents in 1S1-1S2, 4S1-4S2 windings by means of laboratory toroidal current transformers type IL20a class 0,5 with a ratio 2.000/5 A/A (uncertainty of measurement ±0,012% for k = 2) and secondary currents in 5S1-5S2, 6S1-6S2 by shunt 25 A/300 mV class 0,5 (uncertainty of measurement ±0,33 % for k = 2).
- voltage drop (U_0) on test object during short-time current tests by means of a resistance-capacitance voltage divider with a bandwidth from 0 to 100 kHz.



T - short-circuit transformer
CB - back-up circuit-breaker
R - reactor
MS - make switch
CT - current transformers
VD - voltage divider
TO - test object

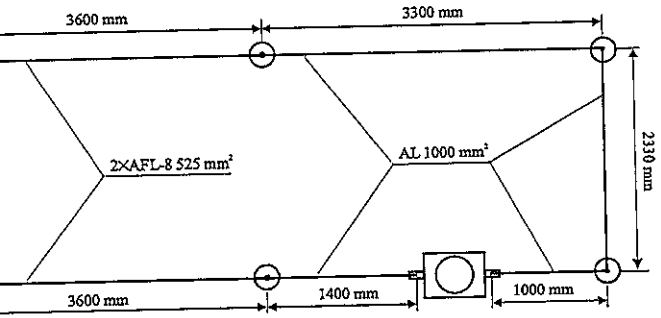


Fig. 2. Configuration of test circuit during tests

D THEIRS DETAILED RESULTS

ts presents tables 1 and 2.
tests the following records were made:
o. 33059 – calibration of measuring and test circuit,
os. 33061, 33063 – short-time current tests,
o. 33067 – composite error test,
(Annex 1 presents the copies of short-circuit test records - all records are stored in laboratory's archives),
hot. 1 – current transformer on short-circuit tests stand
(Annex 2 presents the photograph).

of short-time current tests

z	t_z	$I_z^2 \times t_z$	$I_{1S1\text{-}1S2}$	$I_{4S1\text{-}4S2}$	$I_{5S1\text{-}5S2}$	U_0	Observations
A	s	$(kA)^2 \times s$	A	A	A	V	-
,22	0,06	–	–	–*	–	–	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
,22	1,00	4124[2)]	329	–*	64	33	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

of test current,
of test current (determined from test period without asymmetrical component),
n,
(determined from test period without asymmetrical component),
(determined from test period without asymmetrical component),
(determined from test period without asymmetrical component),
(determined from test period without asymmetrical component).
≥ 158 kA,

During the composite error test current's transformer burden connected to 6S1-6S2 was 10,3 Ω.

Table 2. Results of composite error test for 6S1-6S2 winding

Test No.	I_p	ε_c	t_z	Observations
-	kA	%	s	-
33067	20,34	1,81	1,00	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

Legend:
I_p – r.m.s. value of the test current (determined from test period without asymmetrical component),
t_z – test duration,

$$\varepsilon_c = \frac{\sqrt{\frac{1}{T}\int_0^T (k_r \cdot i_s - i_p)^2 \, dt}}{I_p} \cdot 100\%$$

k_r – rated transformation ratio (1000/1 A/A),
i_p – instantaneous value of the primary current,
i_s – instantaneous value of the secondary current,
T – duration of one cycle.

5. TESTS RESULTS EVALUATION

According to criteria given in IEC 61869-2:2012 the results of tests is positive for:

I_{dyn} = 158 kA, I_{th} = 63 kA, t = 1 s for 1000 A terminal of tested combined instrument transformer.

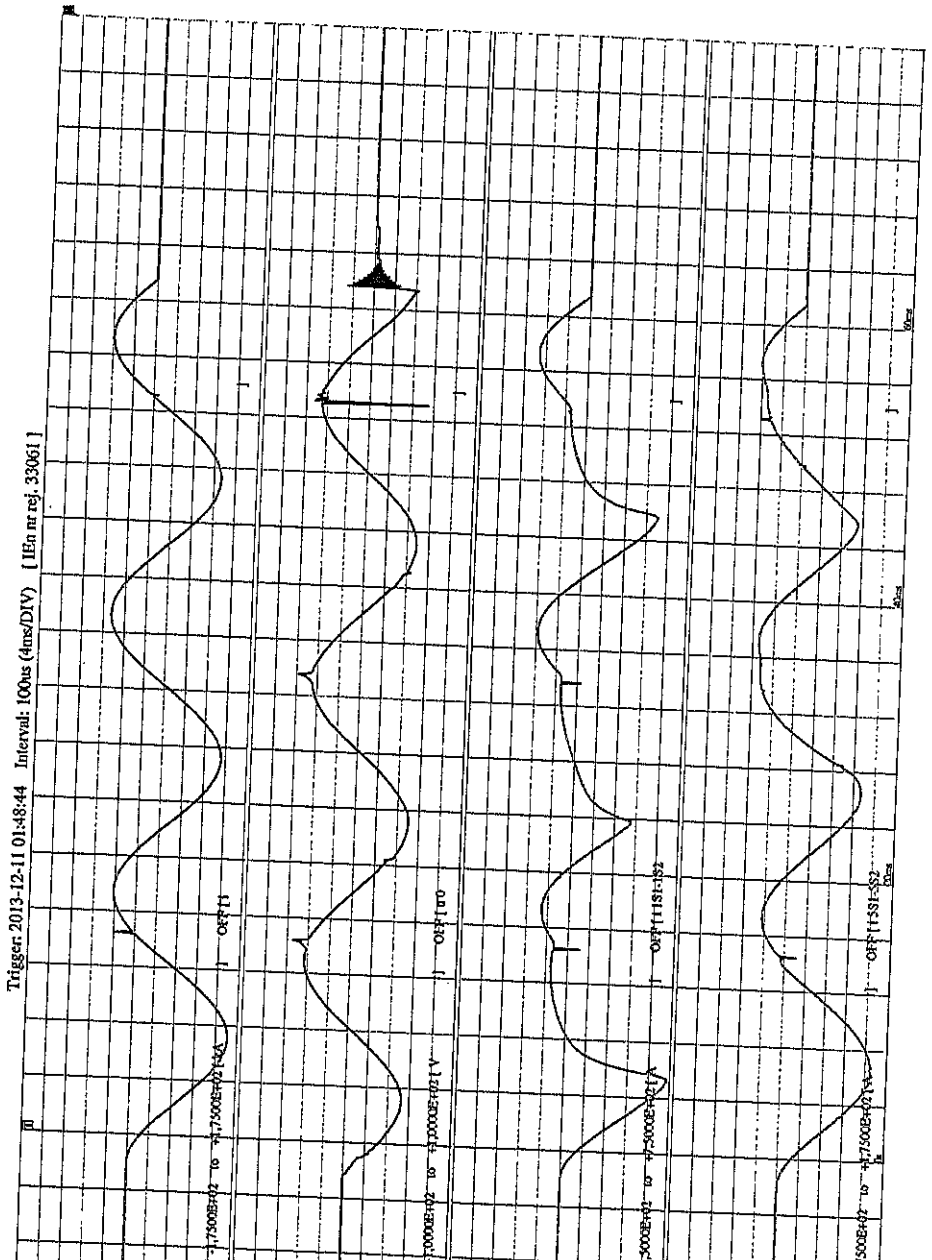
Test records

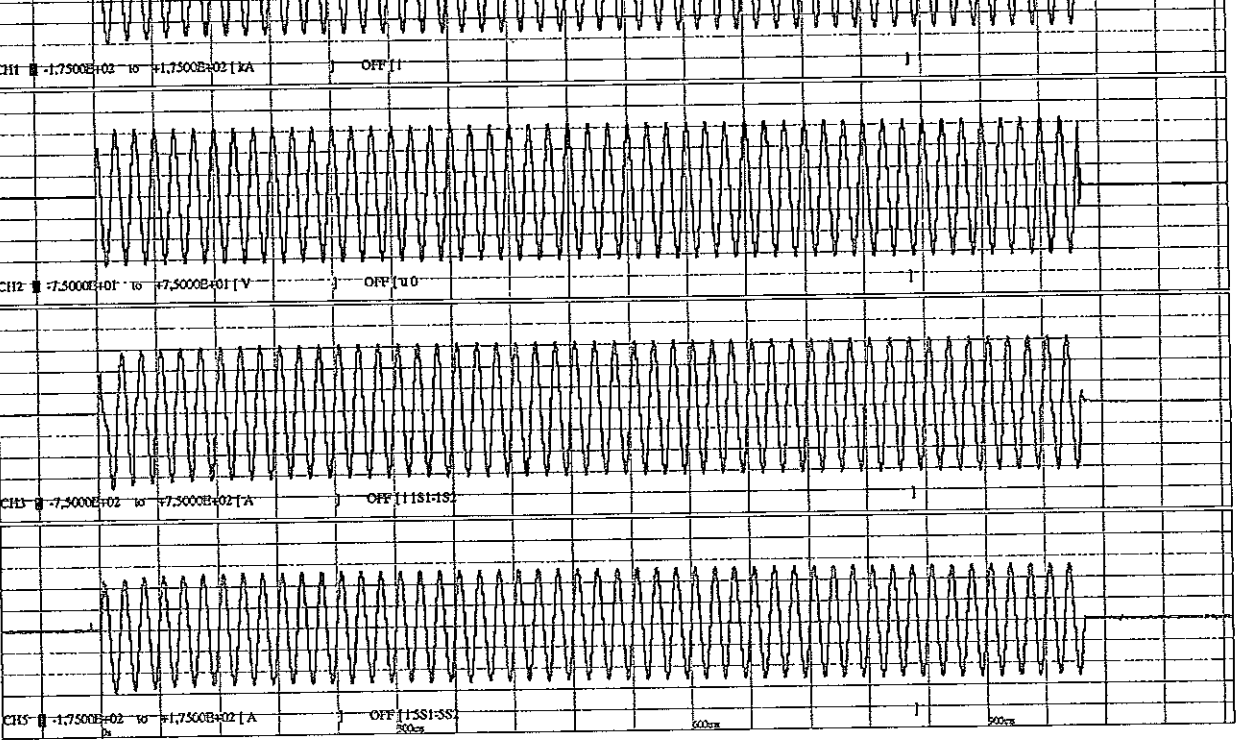
As not numbered pages the following copies of records are given:

33061, 33063 – short-time current tests,
33067 – composite error test.

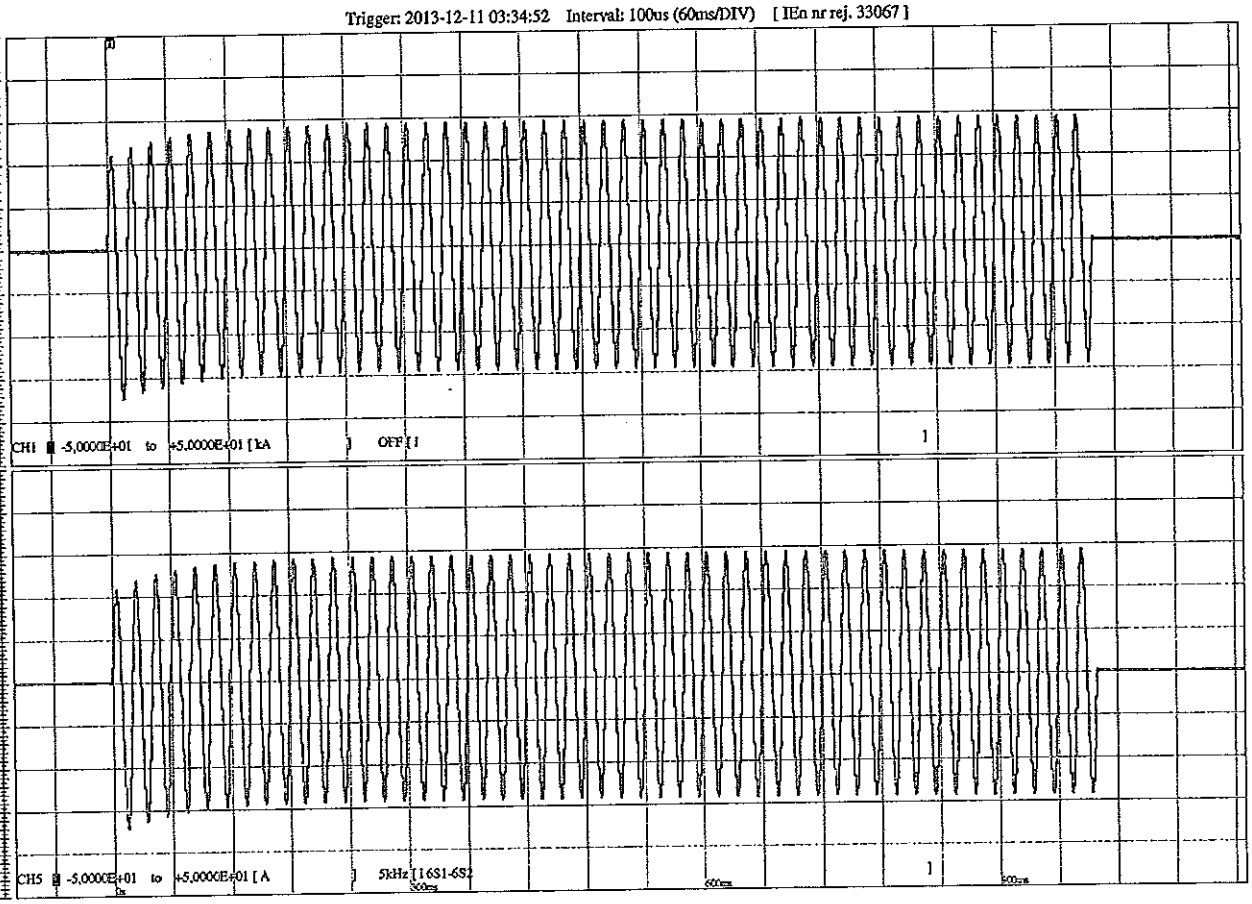
ons:

on test object,
winding current,
winding current,
winding current,
winding current.

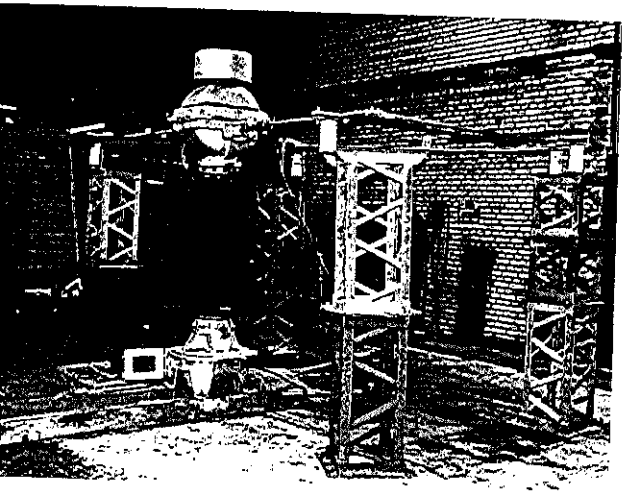




Trigger: 2013-12-11 03:34:52 Interval: 100us (60ms/DIV) [IEn nr rej. 33067]



Photographs taken during the tests



Phot. 1. PVA 145a after short-time current tests

ANNEX 3 Routine test report before and after short-time current tests

ABB Sp. z o.o. 06 – 300 Przasnysz ul. Leszno 59		Routine tests report of combined instrument transformer			TYP: PVA145a Nr fabr. 2GKP013K1486140	
A – N 132:√3 kV	Insulation level: 145/275/650 kV	Voltage factor: 1,9 /8h	Ith 1 s [kA] 63-63	Idyn [kA] 158-158	Ioth [A]: 1200-2400	IEC 61869-4 50 Hz

VOLTAGE PART	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a-1n	0,11:√3	25	0,2	1000
		0,11:√3	25	3,0	1000
	2a-2n	0,11:√3	25	0,2	1000
		0,11:√3	25	3,0	1000
	3a-3n	0,11:√3	25	0,2/3P	1000
		0,11:√3	500	3/3P	1000
	4a-4n	0,11:√3	25	3/3P	1000
		0,11:√3	25	3/3P	1000
	da-dn	0,11	150	1	450
		0,11	400	3P	450

CURRENT PART	Winding	Isn [A]	Sn [VA]	class	Ratio
	1S1-1S2	5	100	0,2FS10	1000-2000/5
	2S1-2S2	1	70	0,1FS5	1000-2000/1
	3S1-3S2	5	35	5P 20	1000-2000/5
	4S1-4S2	5	15	5P 60	1000-2000/5
				PX Ek = 250V Ie <= 0,1A / 125 Rct <= 7Ω Rb = 1 Ω	
	5S1-5S2	1		TPY Kssc = 15 Ktd = 13 Cykl = 0,1s Tp = 0,05 s Rb = 2 Ω Ks <= 10%	1000-2000/1
			30	5P30	
	6S1-6S2	1	10	5PR20 Rct<=8Ω	1000-2000/1
				PXR 2-1/2000 Kx=20 Ek=500V Ie<=0,1A Rct<=5,0 Ω Rb=20 Ω	

List of performer tests

1. Oil dielectric parameters check before filling (oil after tgδ wg IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal ☑
3. Pressure and tightness test: oil overpressure: 0,5 bar / 24h – no traces of oil ☑
4. Power-frequency withstand on primary windings ☑
   – P1+P2/A; Up=275 kV / 60 s, f =97 Hz; N: Up = 3 kV/ 60s, f=50 Hz
5. Partial discharge ☑
6. Power-frequency withstand test on secondary ☑
   – Up = 3 kV/60 s ☑

rvoltage test for current transformers– lower value ☑
(U szczyt. = 4,5 kV lub U szczyt. Przy Icth) / 60s ☑
n of errors ☑
on of the over current factors: FS,ALF ☑
t of capacitance and dielectric dissipation factor (tgδ) ☑
n of core magnetization characteristics ☑
t of windings' resistance ☑

☐

arameters check before filling (oil after treatment)

of oil tgδ according to IEC 60247
%; electrical stress = 1 kV/mm, f=50 Hz, Oil temp. = 90°C±1°C

of breakdown voltage according to IEC 60156
kdown voltage =77,42 kV, Relative standard deviation = 5,64%; f=50 Hz,
°C, measurement with the stirrer, type of electrodes used: partially spherical.

eakdown voltage [kV]
83.2
80.1
70.8
79.2
76.4
74.8

harge measurement
ent according to procedure A (PD test voltages were reached while decreasing the voltage
wer-frequency withstand test on primary winding)
ge: 275 kV / 60 s
97 Hz

	1,2 Um = 174 kV	1,2 Um / √3 = 100,5 kV
lscharge	1,8 pC	1,3 pC

background noise level: 1 (measured after voltage switch off),
circuit was calibrated with 5 pC (calibrating charge).

overvoltage test for current transformers

ding	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
-1S2	4,5	2050
-2S2	4,5	42,5
-3S2	4,5	12
-4S2	4,5	1100
-5S2	1,47	2400
-6S2	4,5	1900

Determination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

Uzwojenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
1a-1n	0,11:√3	25	0,2	1000
2a-2n	0,11:√3	25	0,2	1000
3a-3n	0,11:√3	25	0,2/3P	1000
4a-4n	0,11:√3	25	3/3P	1000
da-dn	0,11	150	1	450

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_i U_n
ε U	-0.021	-0.021	-0.021	
Δφ U	3.1	3.1	3.2	

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_i U_n
ε U	0.017	0.017	0.016	
Δφ U	3.1	3.1	3.2	

2a – 2n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_i U_n
ε U	-0.017	-0.017	-0.017	
Δφ U	3.2	3.2	3.3	

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,8 U_n	1,0 U_n	1,2 U_n	k_i U_n
ε U	0.020	0.021	0.020	
Δφ U	3.2	3.2	3.2	

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.097	-0.100	-0.008	-0.006	-0.009	-0.141
Δφ U	1.8	2.9	3.3	3.3	3.4	1.4

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.054	-0.059	0.029	0.030	0.029	-0.103
Δφ U	1.8	2.8	3.2	3.2	3.3	1.3

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.098	-0.097	-0.008	-0.007	-0.008	-0.818
Δφ U	2.1	3.2	3.6	3.6	3.6	-17.4

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.051	-0.055	0.033	0.033	0.033	-0.778
Δφ U	2.0	3.0	3.4	3.4	3.4	-17.6

da – dn 100 VA; cos fi = 0,8 ind.
1a-1n 25VA; 2a-2n 25VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	0,02 U_n	0,05 U_n	1,0 U_n	1,9 U_n
ε U	-0.611	-0.795	-0.821	-0.854
Δφ U	21.1	11.8	3.8	4.6

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.052	0.053	0.052
Δφ U	4.8	4.8	4.9

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.089	0.090	0.089
Δφ U	4.8	4.8	4.9

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.059	0.059	0.059
Δφ U	4.8	4.8	4.9

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0.097	0.097	0.097
Δφ U	4.8	4.8	4.9

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.023	-0.026	0.064	0.065	0.064	-0.069
Δφ U	3.7	4.7	4.9	4.9	5.0	3.1

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	0.011	0.011	0.101	0.102	0.101	-0.032
Δφ U	3.6	4.6	4.8	4.8	4.9	3.0

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0.024	-0.027	0.062	0.063	0.063	-0.070
Δφ U	3.9	4.9	5.1	5.1	5.2	3.3

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	0.016	0.015	0.103	0.104	0.103	-0.030
Δφ U	3.8	4.7	4.9	4.9	5.0	3.0

da – dn 25 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA ,

	0,02 U_n	0,05 U_n	1,0 U_n	1,9 U_n
ε U	-0.288	-0.492	-0.525	-0.535
Δφ U	24.4	11.9	4.9	5.1

*) at 1,9 Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

rmination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

jenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
1n	0,11:√3	25	3,0	1000
2n	0,11:√3	25	3,0	1000
3n	0,11:√3	500	3/3P	1000
4n	0,11:√3	25	3/3P	1000
dn	0,11	400	3P	450

A; cos fi = 0,8 ind.
-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	$k_r U_n$
37	-0,467	-0,468	
2	-7,2	-7,1	

VA; cos fi = 0,8 ind.
-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	$k_r U_n$
9	-0,430	-0,429	
	-7,2	-7,1	

VA; cos fi = 0,8 ind.
-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	$k_r U_n$
n	-0,509	-0,509	
1	-7,1	-7,0	

VA; cos fi = 0,8 ind.
3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	1,0 U_n	1,2 U_n	$k_r U_n$
	-0,430	-0,430	
0	-7,2	-7,2	

A; cos fi = 0,8 ind.
n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
-1,030	-0,933	-0,933	-0,932	-1,307
4,3	4,6	4,6	4,9	-6,3

A; cos fi = 0,8 ind.
n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
-0,296	-0,204	-0,203	-0,204	-0,565
3,2	3,6	3,6	3,7	-7,6

n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	$k_r U_n$
0,535	-0,442	-0,441	-0,441	-0,818
-6,6	-5,2	-6,2	-5,1	-17,4

n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	$k_r U_n$
0,494	-0,401	-0,400	-0,400	-0,775
-6,7	-6,3	-6,3	-6,3	-17,6

cos fi = 0,8 ind.
VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	0,05 U_n	1,0 U_n	1,9 U_n
	-1,727	-1,673	-1,692
	-2,9	-3,6	-2,6

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,052	0,053	0,052
Δφ U	4,8	4,8	4,9

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,069	0,090	0,089
Δφ U	4,8	4,8	4,9

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,045	0,046	0,047
Δφ U	3,7	3,7	3,8

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	0,8 U_n	1,0 U_n	1,2 U_n
ε U	0,094	0,095	0,094
Δφ U	4,8	4,8	4,9

3a – 3n 500 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,963	-0,956	-0,863	-0,862	-0,861	-1,238
Δφ U	5,1	6,1	6,5	6,5	6,6	-4,6

3a – 3n 125 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,224	-0,225	-0,134	-0,133	-0,133	-0,513
Δφ U	3,9	5,0	5,2	5,3	5,3	-5,9

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	-0,028	-0,026	0,062	0,063	0,063	-0,317
Δφ U	3,9	4,9	5,1	5,1	5,2	-6,3

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	0,02 U_n	0,05 U_n	0,8 U_n	1,0 U_n	1,2 U_n	1,9 U_n*
ε U	0,017	0,015	0,103	0,104	0,103	-0,275
Δφ U	3,7	4,7	4,9	4,9	5,0	-6,3

da – dn 75 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA

	0,02 U_n	0,05 U_n	1,0 U_n	1,9 U_n
ε U	-0,628	-0,682	-0,630	-0,635
Δφ U	9,2	7,1	5,3	6,0

Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

Determination of current part errors (ε I %), (Δφ I min),
Ipn (A): 1000

1S1-1S2 100 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	-0.303	-0.138	-0.017	-0.006
Δφ I	8.6	5.0	1.9	1.6

1S1-1S2 25 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	-0.006	0.097	0.146	0.150
Δφ I	5.8	3.1	1.6	1.5

2S1-2S2 70 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	-0.078	-0.056	-0.009	-0.015
Δφ I	1.5	0.4	-0.6	-0.2

2S1-2S2 17.50 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	0.018	0.010	0.023	0.026
Δφ I	0.6	0.6	-0.0	-0.1

3S1-3S2: 35 VA cosφ = 0,8	
	1,0 In
ε I	-0.138
Δφ I	1.0

4S1-4S2: 15 VA cosφ = 0,8	
	1,0 In
ε I	-0.036
Δφ I	0.6

5S1-5S2: 30 VA cosφ = 0,8	
	1,0 In
ε I	-2.510
Δφ I	118.1

6S1-6S2: 15 VA cosφ = 0,8	
	1,0 In
ε I	-0.974
Δφ I	20.8

Ipn (A): 2000

1S1-1S2 100 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	-0.302	-0.138	-0.018	-0.006
Δφ I	8.6	4.9	1.8	1.6

1S1-1S2 25 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	0.005	0.098	0.146	0.151
Δφ I	6.6	3.1	1.5	1.4

2S1-2S2 70 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	-0.096	-0.071	-0.027	-0.047
Δφ I	2.3	0.9	0.1	1.2

2S1-2S2 17,50 VA; cosφ = 0,8				
	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
ε I	0.009	-0.003	0.008	0.014
Δφ I	1.2	1.2	0.6	0.3

3S1-3S2: 35 VA cosφ = 0,8	
	1,0 In
ε I	-0.138
Δφ I	0.9

4S1-4S2: 15 VA cosφ = 0,8	
	1,0 In
ε I	-0.037
Δφ I	0.5

5S1-5S2: 30 VA cosφ = 0,8	
	1,0 In
ε I	-2.510
Δφ I	117.8

6S1-6S2: 15 VA cosφ = 0,8	
	1,0 In
ε I	-0.974
Δφ I	20.8

Current part: Measurements uncertainty: **ε I = ±0,046 %, Δφ I = ±2,3 min**
Voltage part: Measurements uncertainty: **ε U = ±0,044 %, Δφ U = ±2,2 min**

Determination of the over current factors:

- instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	E_{FS} [V]	Condition	Assessment
1S1-1S2	5	153.33	422.24	$U < E_{FS}$	☑
2S1-2S2	0.5	157.46	531.29	$U < E_{FS}$	☑

nit factor (ALF) – test for composite error ε_c of protective cores

	E_{ALF} [V]	Ie [A]	ε_c [%]	Condition	Assessment
		0.02	0.1	ε_c < 5%	☑
	363.35	0.123	0.04	ε_c < 5%	☑
		1.298	4.33	ε_c < 5%	☑
	877.45	0.227	1.14	ε_c < 5%	☑

n of parameters of class PX: core 4S1-4S2

	1000	2000
	38.39	37.18

n of parameters of class TPY core 5S1-5S2:

	1000	2000
	15.78	15.41
	12.78	12.75
	0	0
or [%]	-0.164	-0.167
	0.4446	0.4369
	9.44	9.67

n of parameters of class PXR core 6S1-6S2:

	1000	2000
	26.69	26.68
	3	3

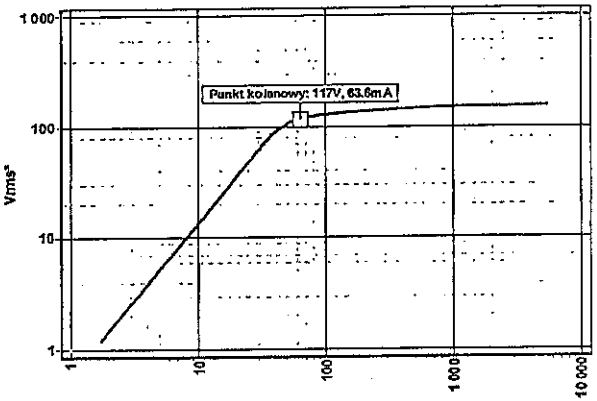
of capacitance and dielectric dissipation factor (tg δ)
: 22,3 °C, Frequency: 50 Hz

trument transformer			Current part			Voltage part		
δ	Capacity	Leak current	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current
	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
4	1418	4.464	0.25	1141	3.587	0.22	276	0.87
4	1418	27.97	0.24	1141	22.51	0.22	276	5.452
4	1418	31.67	0.24	1142	25.51	0.22	276	6.173

Core magnetization characteristics:

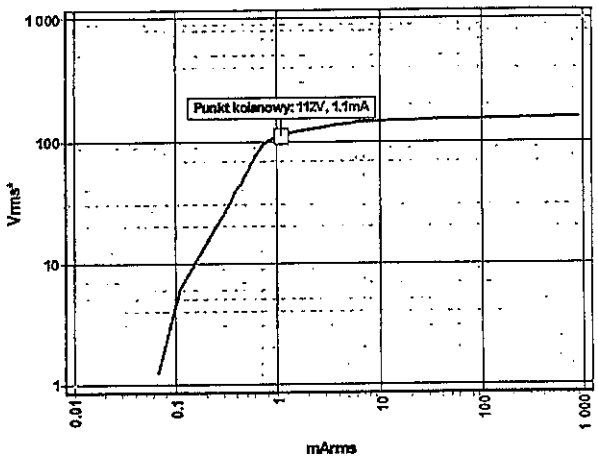
Winding 1S1-1S2

[V]	[mA]
153.7	5351.9
147.9	1328.8
138.4	230.4
132.6	126.3
129.2	100.62
123	74.91
115.7	60.14
109.5	52.58
103.2	47.64
90.8	40.94
71.3	33.03
51.6	25.9
31.8	18.59
12	9.22
1.2	1.77



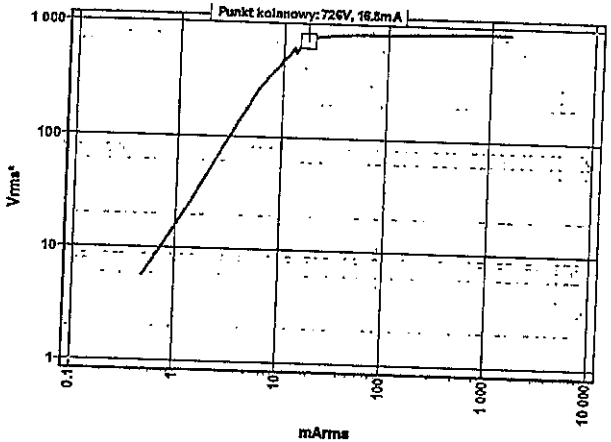
Winding 2S1-2S2

[V]	[mA]
159.5	908.5
146.9	8.19
136.8	3.68
127	1.99
123.3	1.67
117	1.27
110.7	1.02
103.3	0.86
97.1	0.76
91	0.7
71.4	0.57
51.8	0.47
32.1	0.35
12.3	0.18
1.2	0.07



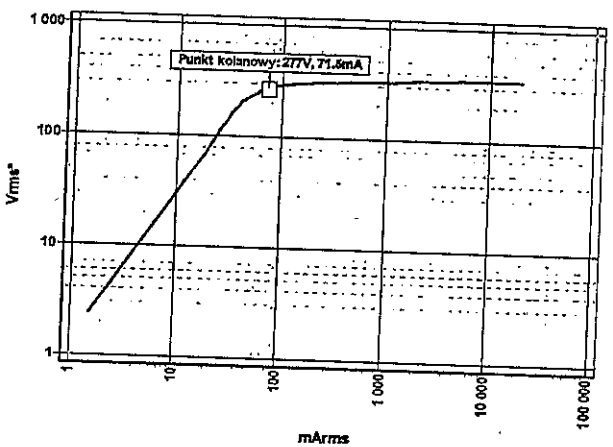
1-3S2

[mA]
22.2
5.7
7.5
.04
.98
.93
.82
.51
.27
.19
5
.3
4
1
7



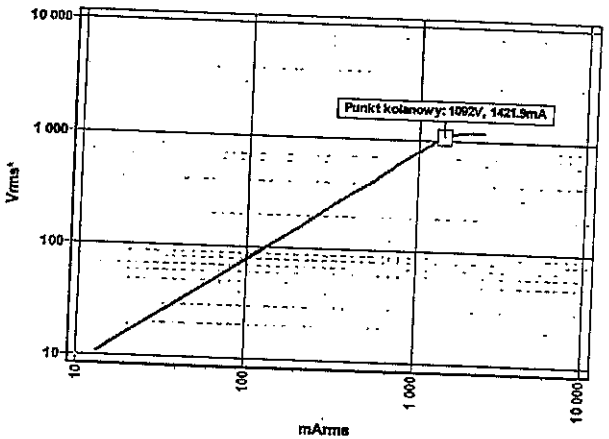
1S2

1
9
8
4
7
5



Winding 5S1-5S2

[V]	[mA]
1201.7	2415
1181.1	1753.8
1160.8	1591.9
1134.3	1500.1
1113.1	1455.9
1084.1	1408.2
1053.8	1363.1
1027.3	1326
917.3	1177
757.2	968.7
598.5	765.3
435.7	557.9
271.4	348
104.7	135
10.9	13.35



Measurement of windings' resistance

Windings' resistance of current part:

	R (23°C)	R ct (75°C)
P1-P2 range 1000 A	90.0 μΩ	108.4 μΩ
P1-P2 range 2000 A	41.0 μΩ	49.4 μΩ
1S1-1S2	0.455 Ω	0.548 Ω
2S1-2S2	6.390 Ω	7.696 Ω
3S1-3S2	3.353 Ω	4.038 Ω
4S1-4S2	0.392 Ω	0.472 Ω
5S1-5S2	3.648 Ω	4.391 Ω
6S1-6S2	3.924 Ω	4.726 Ω

Windings' resistance of voltage part:

	R (24,9°C)	R ct (75°C)
A-N	21.70 kΩ	26.135 kΩ
1a-1n	47.300 mΩ	56.966 mΩ
2a-2n	48.710 mΩ	58.664 mΩ
3a-3n	50.200 mΩ	60.459 mΩ
4a-4n	51.800 mΩ	62.386 mΩ
Da-dn	114.100 mΩ	137.417 mΩ

Checked by: OG-4 KJ-06

Przasnysz. 12.11.2013 r.

o. z o.o.	Routine tests report of combined instrument transformer after short time current test			TYP: PVA145a Nr fabr. 2GKP013K1486140	
Przasnysz					
szno 59					
Insulation level: 145/275/650 kV	Voltage factor: 1,9 /8h	Ith 1 s [kA] 63-63	Idyn [kA] 158-158	Icth [A]: 1200-2400	IEC 61869-4 50 Hz

RT	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a-1n	0,11:√3	25	0,2	1000
		0,11:√3	25	3,0	1000
	2a-2n	0,11:√3	25	0,2	1000
		0,11:√3	25	3,0	1000
	3a-3n	0,11:√3	25	0,2/3P	1000
		0,11:√3	500	3/3P	1000
	4a-4n	0,11:√3	25	3/3P	1000
		0,11:√3	25	3/3P	1000
	da-dn	0,11	150	1	450
		0,11	400	3P	450

RT	Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
	1S1-1S2	5	100	0,2FS10	1000-2000/5
	2S1-2S2	1	70	0,1FS5	1000-2000/1
	3S1-3S2	1	35	5P 20	1000-2000/1
	4S1-4S2	5	15	5P 60	1000-2000/5
				PX Ek = 250V Ie <= 0,1A / 125 V Rct <= 0,5 Ω Rb = 1 Ω	
	5S1-5S2	1		TPY Kssc = 15 Ktd = 13 Cykl = 0,1s Tp = 0,05 s Rb = 2 Ω K_{ss} <= 10%	1000-2000/1
			30	5P30	
	6S1-6S2	1	10	5PR20 Rct <= 8Ω	1000-2000/1
				PXR 2-1/2000 Kx = 20 Ek = 500V Ie <= 0,1A / 250 V Rct <= 5,0 Ω Rb = 20 Ω	

mer tests

- e parameters check before filling (oil after — ☑
- 60247, breakdown voltage acc. IEC 60156 — ☑
- of terminal — ☑
- nd tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil — ☑
- uency withstand on primary windings — ☑
  – P1+P2/A;Up=247,5 kV / 60 s,f =97 Hz; N; Up = 3 kV/ 60s, f=50 Hz

5. Partial discharge — ☑
6. Power-frequency withstand test on secondary – Up = 3 kV/60 s — ☑
7. Inter-turn overvoltage test for current transformers– lower value (U szczyt. = 4,5 kV lub U szczyt. Przy Icth) / 60s — ☑
8. Determination of errors — ☑
9. . Determination of the over current factors: FS, — ☑
10. Measurement of capacitance and dielectric dissipation factor (tgδ) — ☑
11. Determination of core magnetization characteristics — ☑
12. Measurement of windings' resistance — ☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tgδ according to IEC 60247
  Tgδ = 0,08%; electrical stress = 1 kV/mm, f=50 Hz, Oil temp. = 90°C±1°C

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage =77,42 kV, Relative standard deviation = 5,64%; f=50 Hz, oil temp. = 26 °C, measurement with the-stirrer, type of electrodes used: partially spherical.

Sample	Breakdown voltage [kV]
1	83.2
2	80.1
3	70.8
4	79.2
5	76.4
6	74.8

Partial discharge measurement

- Measurement according to procedure B
Stress voltage 247,5 kV / 60 s
Frequency 97 Hz

Test voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100,5 kV
Level of partial discharge	1,8 pC	1,2 pC

Remarks: background noise level: 1 (measured after voltage switch off), measuring circuit was calibrated with 5 pC (calibrating charge).

Inter-turn overvoltage test for current transformers

Winding	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
1S1-1S2	4,5	2050
2S1-2S2	4,5	400
3S1-3S2	4,5	135
4S1-4S2	4,5	1100
5S1-5S2	1,47	2400
6S1-6S2	4,5	1750

termination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

ding	Usn [kV]	Sn [VA]	class	Sth [VA]
-1n	0,11:√3	25	0,2	1000
-2n	0,11:√3	25	0,2	1000
-3n	0,11:√3	25	0,2/3P	1000
-4n	0,11:√3	25	3/3P	1000
-dn	0,11	150	1	450

/A; cos fi = 0,8 ind.
a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
U	-0,019	-0,020		
020	3,2	3,2		

VA; cos fi = 0,8 ind.
a-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
U	0,018	0,018		
1	3,2	3,3		

VA; cos fi = 0,8 ind.
3a-3n 25 VA; 4a-4n 25 VA. cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
U	-0,011	-0,012		
2	3,2	3,3		

VA; cos fi = 0,8 ind.
-3n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
U_n	0,028	0,025		
6	3,2	3,3		

; cos fi = 0,8 ind.
2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
U	-0,099	-0,007	-0,008	-0,007	-0,144
0	3,0	3,3	3,3	3,4	1,2

VA; cos fi = 0,8 ind.
2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
U	-0,058	0,030	0,031	0,030	-0,109
0	2,9	3,2	3,2	3,3	1,2

cos fi = 0,8 ind.
n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
U	-0,097	-0,006	-0,005	-0,006	-0,142
0	3,3	3,6	3,6	3,6	1,5

cos fi = 0,8 ind.
n 25 VA; 3a-3n 25 VA cos fi = 0,8 ind

	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
U	-0,055	0,034	0,035	0,034	-0,101
0	3,1	3,4	3,4	3,4	1,3

; cos fi = 0,8 ind.
5VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	$0,05\ U_n$	$1,0\ U_n$	$1,9\ U_n$
	-0,926	-0,839	-0,842
	4,1	4,6	5,5

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,052	0,053	0,052
Δφ U	4,8	4,8	4,9

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,090	0,091	0,090
Δφ U	4,8	4,8	4,9

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,060	0,061	0,060
Δφ U	4,9	4,9	4,9

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,098	0,099	0,098
Δφ U	4,8	4,8	4,9

3a – 3n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,023	-0,026	0,064	0,065	0,064	-0,069
Δφ U	3,7	4,7	4,9	4,9	5,0	2,9

3a – 3n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	0,011	0,011	0,101	0,102	0,101	-0,032
Δφ U	3,5	4,6	4,8	4,9	4,9	2,8

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,025	-0,025	0,064	0,065	0,064	-0,071
Δφ U	3,9	4,9	5,1	5,1	5,2	3,1

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	0,017	0,014	0,104	0,105	0,104	-0,031
Δφ U	3,7	4,7	4,9	4,9	5,0	2,9

da – dn 37,5 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA,

	$0,02\ U_n$	$0,05\ U_n$	$1,0\ U_n$	$1,9\ U_n$
ε U	-0,602	-0,610	-0,522	-0,523
Δφ U	3,9	5,0	5,2	6,1

Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

Determination of voltage part errors (ε U %), (Δφ U min), cosφ = 0,8

Uzwojenie	Usn [kV]	Sn [VA]	klasa	Sth [VA]
1a-1n	0,11:√3	25	3,0	1000
2a-2n	0,11:√3	25	3,0	1000
3a-3n	0,11:√3	500	3/3P	1000
4a-4n	0,11:√3	25	3/3P	1000
da-dn	0,11	400	3P	450

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,459	-0,459	-0,461	
Δφ U	-7,4	-7,4	-7,3	

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,422	-0,422	-0,423	
Δφ U	-7,4	-7,4	-7,3	

2a – 2n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA, cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,453	-0,453	-0,454	
Δφ U	-7,4	-7,4	-7,4	

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 3a-3n 500 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,416	-0,416	-0,417	
Δφ U	-7,4	-7,4	-7,4	

3a – 3n 500 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-1,031	-1,031	-0,934	-0,932	-0,933	-1,280
Δφ U	3,0	4,1	4,7	4,7	4,8	-2,0

3a – 3n 125 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 4a-4n 25 VA cos fi = 0,8 ind

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,295	-0,295	-0,205	-0,203	-0,205	-0,555
Δφ U	2,2	3,3	3,7	3,7	3,7	-3,2

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,515	-0,522	-0,435	-0,436	-0,435	-0,790
Δφ U	-8,9	-7,4	-6,3	-6,3	-6,3	-13,0

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 25 VA; 2a-2n 25 VA; 3a-3n 500 VA cos fi = 0,8 ind

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$k_t\ U_n$
ε U	-0,478	-0,483	-0,394	-0,394	-0,394	-0,746
Δφ U	-9,1	-7,7	-6,6	-6,6	-6,5	-13,2

da – dn 400 VA; cos fi = 0,8 ind.
1a-1n 25VA; 2a-2n 25VA; 3a-3n 500VA; 4a-4n 25VA, cos fi = 0,8 ind

	$0,02\ U_n$	$0,05\ U_n$	$1,0\ U_n$	$1,9\ U_n$
ε U	-1,790	-1,790	-1,728	-1,674
Δφ U	-5,3	-4,0	-1,9	-3,0

1a – 1n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,053	0,053	0,053
Δφ U	4,8	4,8	4,8

1a – 1n 6,25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,090	0,091	0,090
Δφ U	4,8	4,8	4,9

2a – 2n 25 VA; cos fi = 0,8 ind.
2a-2n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA.

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,061	0,062	0,061
Δφ U	4,8	4,8	4,9

2a – 2n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 3a-3n 0 VA; 4a-4n 0 VA

	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$
ε U	0,099	0,099	0,099
Δφ U	4,8	4,8	4,9

3a – 3n 500 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,956	-0,957	-0,862	-0,861	-0,860	-1,208
Δφ U	4,7	5,8	6,3	6,3	6,4	-0,3

3a – 3n 125 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 4a-4n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,224	-0,226	-0,133	-0,132	-0,133	-0,461
Δφ U	4,0	5,0	5,3	5,3	5,3	-1,5

4a – 4n 25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	-0,026	-0,027	0,062	0,063	0,063	-0,286
Δφ U	3,9	4,9	5,1	5,1	5,2	-1,6

4a – 4n 6,25 VA; cos fi = 0,8 ind.
1a-1n 0 VA; 2a-2n 0 VA; 3a-3n 0 VA

	$0,02\ U_n$	$0,05\ U_n$	$0,8\ U_n$	$1,0\ U_n$	$1,2\ U_n$	$1,9\ U_n$*
ε U	0,017	0,016	0,104	0,105	0,104	-0,244
Δφ U	3,7	4,7	4,9	4,9	5,0	-1,9

da – dn 75 VA; cos fi = 0,8 ind.
1a-1n 0VA; 2a-2n 0VA; 3a-3n 0VA; 4a-4n 0VA,

	$0,02\ U_n$	$0,05\ U_n$	$1,0\ U_n$	$1,9\ U_n$
ε U	-0,717	-0,725	-0,637	-0,637
Δφ U	4,3	5,3	5,6	6,8

*) at 1,9 Un winding da-dn is loaded with Sn, cos fi = 0,8 ind.

of current part errors (ε I %), (Δφ I min),

100 VA;			cosφ = 0,8	1S1-1S2 25 VA;			cosφ = 0,8
	0,2 I_n	1,0 I_n	1,2 I_n	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
	-0.135	-0.014	-0.003	-0.011	0.098	0.148	0.152
	4.9	1.9	1.7	5.9	3.1	1.8	1.5
70 VA;			cosφ = 0,8	2S1-2S2 17,50 VA;			cosφ = 0,8
	0,2 I_n	1,0 I_n	1,2 I_n	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
	-0.053	-0.008	-0.013	0.019	0.010	0.023	0.027
	0.4	-0.6	-0.2	0.8	0.7	0.1	0.0

A	cosφ = 0,8	4S1-4S2: 15 VA	cosφ = 0,8
			1,0 In
		ε I	-0.034
		Δφ I	0.6

A	cosφ = 0,8	6S1-6S2: 15 VA	cosφ = 0,8
			1,0 In
		ε I	-0.815
		Δφ I	14.9

100 VA;			cosφ = 0,8	1S1-1S2 25 VA;			cosφ = 0,8
	0,2 I_n	1,0 I_n	1,2 I_n	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
	-0.136	-0.016	-0.005	-0.003	0.098	0.147	0.151
	4.9	1.8	1.6	5.6	3.1	1.6	1.5
2S2 70 VA;			cosφ = 0,8	2S1-2S2 17,50 VA;			cosφ = 0,8
	0,2 I_n	1,0 I_n	1,2 I_n	0,05I_n	0,2 I_n	1,0 I_n	1,2 I_n
	-0.053	-0.008	-0.004	0.021	0.012	0.024	0.027
	0.4	-0.6	-0.7	0.5	0.5	-0.1	-0.1

A	cosφ = 0,8	4S1-4S2: 15 VA	cosφ = 0,8
			1,0 In
		ε I	-0.035
		Δφ I	0.6

A	cosφ = 0,8	6S1-6S2: 15 VA	cosφ = 0,8
			1,0 In
		ε I	-0.820
		Δφ I	14.9

Measurements uncertainty: ε I = ±0,045 %, Δφ I = ±2,3 min
Measurements uncertainty: ε U = ±0,044 %, Δφ U = ±2,2 min

ion of the over current factors:

security factor (FS) of measuring cores

	Ie [A]	U [V]	E_{FS} [V]	Condition	Assessment
	5	153.46	422.08	$U < E_{FS}$	☑
	0.5	157.29	530.14	$U < E_{FS}$	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Uzwojenie	E_{ALF} [V]	Ie [A]	ε_c [%]	Condition	Assessment
3S1-3S2		0.02	0.1	$\varepsilon_c < 5\%$	☑
4S1-4S2	363.63	0.123	0.04	$\varepsilon_c < 5\%$	☑
5S1-5S2		1.296	4.32	$\varepsilon_c < 5\%$	☑
6S1-6S2	876.63	0.097	0.49	$\varepsilon_c < 5\%$	☑

Determination of parameters of class PX core 4S1-4S2:

4S1-4S2		
Ipn (A)	1000	2000
factor Kx	38.67	38.64

Determination of parameters of class TPY core 5S1-5S2:

Ipn (A)	1000	2000
factor Kssc	15.81	15.81
factor Ktd	12.78	12.78
factor Kr [%]	0	0
Błąd przekładni prądowej [%]	-0.124	-0.127
Ts [s]	0.4452	0.4453
ε-peak [%]	9.423	9.421

Determination of parameters of class PXR core 6S1-6S2:

Ipn (A)	1000	2000
factor Kx	26.64	26.64
factor Kr [%]	3	3

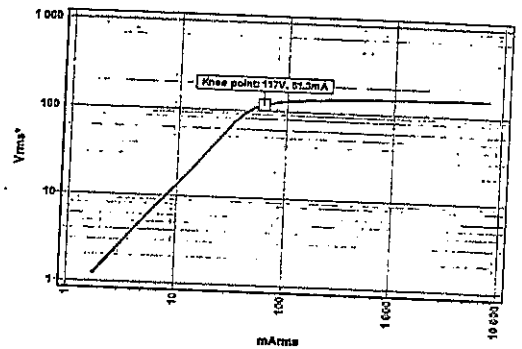
Measurement of capacitance and dielectric dissipation factor (tg δ)
Temperature: 22,3 °C, Frequency: 50 Hz

Primary voltage	Instrument transformer			Current part			Voltage part		
	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current	Tg δ	Capacity	Leak current
	[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
10 kV	0.23	1417	4.448	0.24	1140	3.585	0.22	276	0.868
63 kV	0.23	1417	28.01	0.24	1141	22.57	0.22	276	5.468
71 kV	0.23	1417	31.75	0.24	1141	25.54	0.22	276	6.195

etization characteristics:

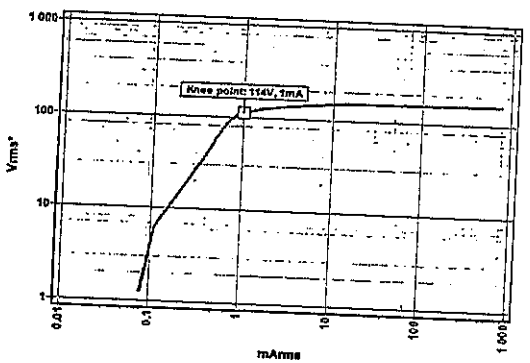
1-1S2

[mA]
7322.0
1271.5
221.3
93.4
77.83
63.60
53.86
48.16
44.30
41.08
33.06
25.96
18.69
9.32
1.79



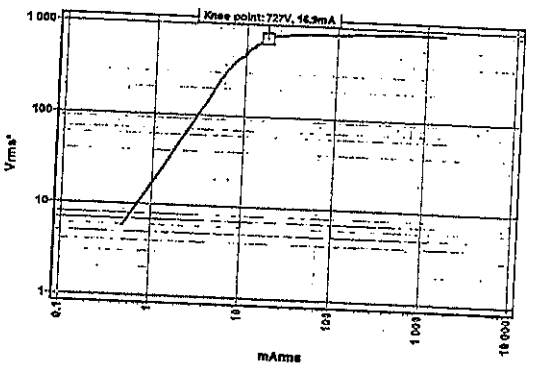
2S2

A]
.3
39
4
8
4
1
5
9
5



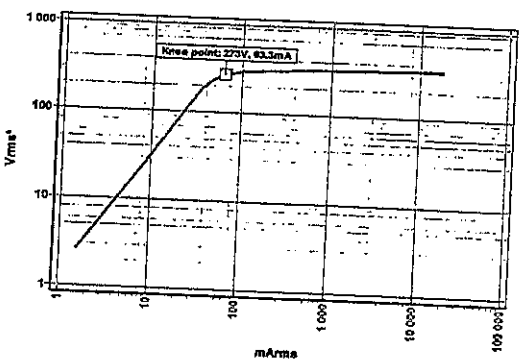
Winding 3S1-3S2

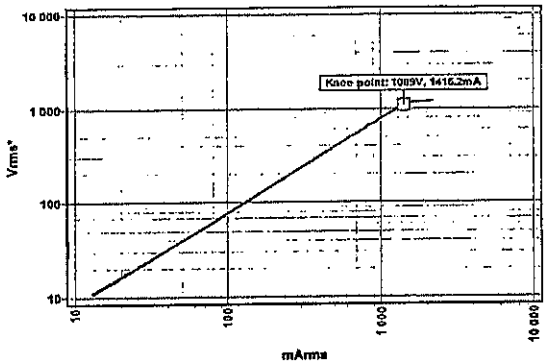
[V]	[mA]
800.2	1567.4
800.2	27.88
769.4	20.32
758.0	19.38
741.3	17.54
725.8	16.86
711.9	16.64
682.3	15.75
655.2	14.63
538.0	10.97
423.5	8.46
310.9	6.22
198.3	4.63
84.1	2.73
5.8	0.48

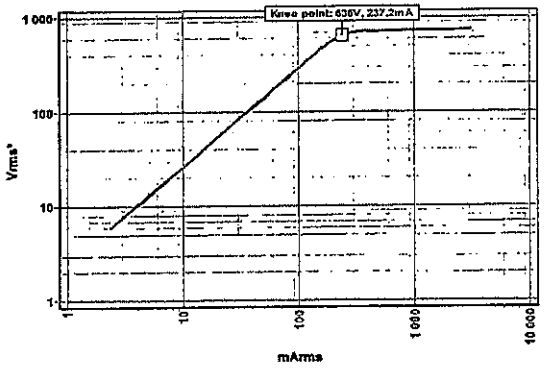


Winding 4S1-4S2

[V]	[mA]
355.1	17673
328.8	525.6
303.0	109.9
300.7	100.68
292.6	83.50
284.2	72.44
271.3	61.54
257.7	54.20
241.0	47.48
199.9	38.64
157.3	31.17
112.8	24.22
59.8	17.44
26.0	8.64
2.8	1.55







Measurement of windings' resistance

Windings' resistance of current part:

	R (23°C)	R ct (75°C)
P1-P2 zakres 1000 A	145.0 µΩ	173.5 µΩ
P1-P2 zakres 2000 A	77.0 µΩ	92.1 µΩ
1S1-1S2	0.455 Ω	0.544 Ω
2S1-2S2	6.200 Ω	7.418 Ω
3S1-3S2	3.352 Ω	4.011 Ω
4S1-4S2	0.395Ω	0.473 Ω
5S1-5S2	3.710 Ω	4.439 Ω
6S1-6S2	3.909 Ω	4.677 Ω

Windings' resistance of voltage part:

	R (24,9°C)	R ct (75°C)
A-N	21.60 kΩ	25.844 kΩ
1a-1n	46.940 mΩ	56.164 mΩ
2a-2n	48.610 mΩ	58.162 mΩ
3a-3n	49.930 mΩ	59.741 mΩ
4a-4n	51.500 mΩ	61.620 mΩ
Da-dn	113.700 mΩ	136.042 mΩ

Checked by: ...Jurcan.....OG-4 KJ-06

Przasnysz. 20.12.2013 r.

Documentations delivered by orderer

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 093/2013 (EN)
(acc. to ISO/IEC 17050-1)

nufacturer: ABB Sp. z o.o. Dept. in Przasnysz

dress: Str. Leszno 59
06-300 Przasnysz / POLAND

duct: Combined Instrument Transformer PVA 145a

ve mentioned product comforms with the following standard :

andard	Title	Edition/Date
61869 - 4	Combined Instrument Transformers	2013

tional Information:
al numbers: **2GKP013K1486140;**

e and date of issue of declaration

snysz 13.01.2014

ABB Sp. z o.o.
ul. Zegańska 1, 04-713 Warszawa
NIP: 526-030-44-84; PL 5260304484
Regon 010017168
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
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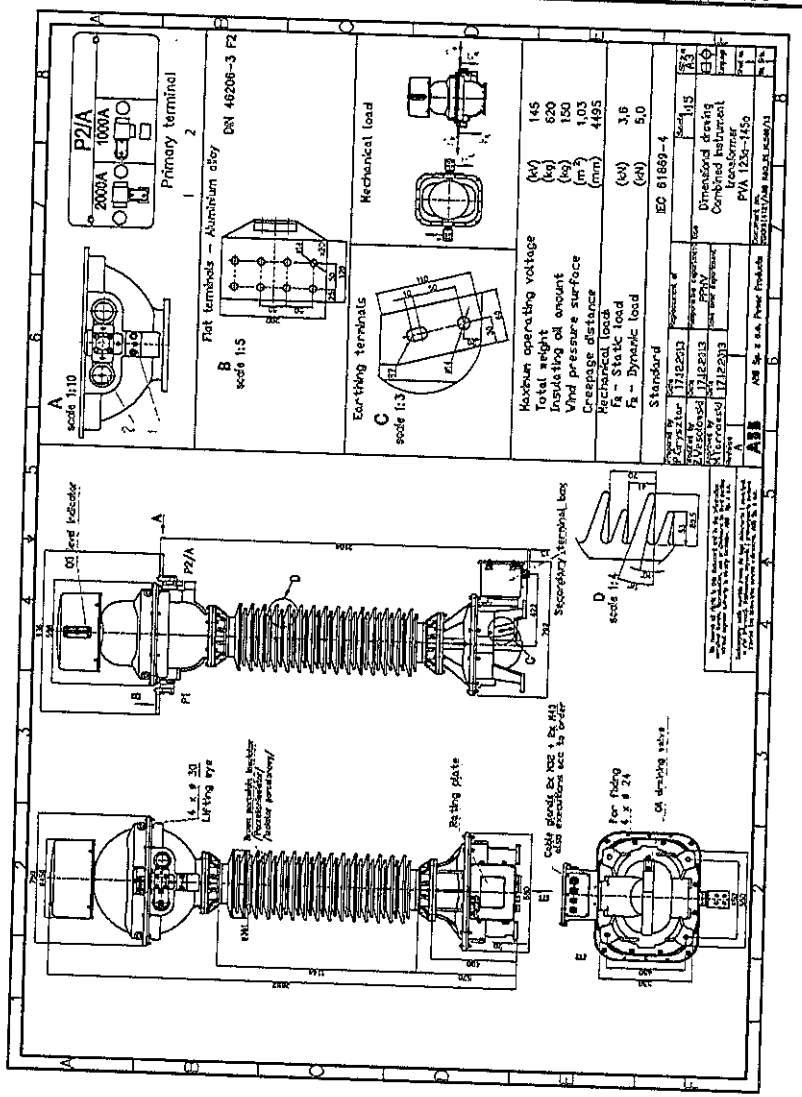
...ierownik ds. Zapewnienia Jakości
ABB Sp. z o.o.
Oddział w Przasnyszu
Krzysztof Łuberski

(Name) (Signature)



ABB

ned Instrument Transformer | Type PVA 145a

el	145/275/650 kV	Standard	IEC 61869-4	fn	50 Hz
	Nytro Libra	Weight / Oil weight	620 / 150 kg	Temp.range	-50°C --- +40°C
	P013K1486140	Voltage factor	1,9Un/8h	Uo	0,2 mV/kA

CURRENT PART

0-2000 / 5-1-1-5-1-1 A/A

- 63 kA I_{dyn} 158 - 158 kA

- 2400 A

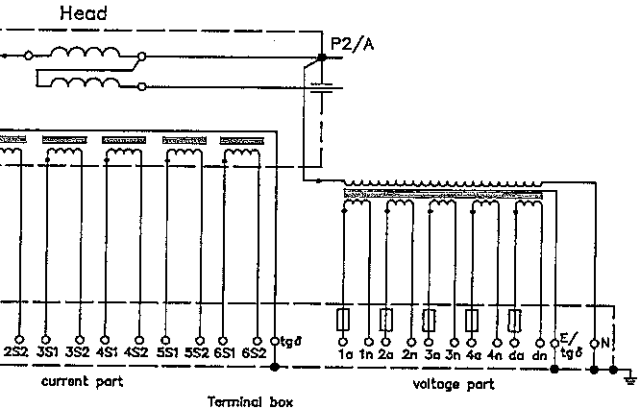
VA	Klasa	FS/ALF	Ext.%
100	0,2	10	120
70	0,1	5	120
35	5P	20	-
15	5P	60	-
Rb=1Ω, klasa PX, Ek=250V, Ie<=0,1 A, Rct <=7Ω			
Rb=2Ω, klasaTPY 15x13, Rct <=7Ω ,Ta=500 ms, cykl 100 ms, Tp=50 ms			
10 VA, klasa 5PR20, Rct<= 8 Ω			
Rb=20Ω, klasa PXR, 2-1/2000, Ek=500 V, Ie<=0,1 A / 250 V, Rct<= 5Ω , Kx=20			

VOLTAGE PART

A-N 132:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	110:√3	110:√3	110:√3	110:√3	110
VA	25	25	25	25	150
Klasa	0,2	0,2	0,2/3P	3/3P	1,0
VA	(25)	(25)	(500)	(25)	(400)
Klasa	(3)	(3)	(3/3P)	(3/3P)	(3P)
VAss	1000	1000	1000	1000	450

Transportation Vertical/Horizontal



nstrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 – XS2
NG INSTRUMENT TRANSFORMER OPERATION TERMINALS: N, E/tgδ, tgδ MUST BE EARTHED
WINDINGS da - dn ARE CONNECTED IN BROKEN DELTA THE CIRCUIT SHOULD BE EARTHED IN ONE POINT ONLY

Instytut Elektrotechniki
Electrotechnical Institute

RIÓW INSTYTUTU ELEKTROTECHNIKI
DAWCZE APARATURY ROZDZIELCZEJ
03 WARSZAWA
+48 22 812 04 07

ry is accredited by Polish Centre of Accreditation,
signatory of EA MLA. No. AB 074

AB 074

TEST REPORT No. 8596/A/NZL/NBR/15

Current transformer
PA 145a

ABB Sp. z o.o.
ul. Leszno 59, 06-300 Przasnysz

ABB Sp. z o.o.
ul. Leszno 59, 06-300 Przasnysz

Short-time current tests

PN-EN 61869-2:2013-06

504-021300/038

23 January 2015 r.

POSITIVE

Head of Laboratories of the
Electrotechnical Institute

Robert Franaszek, M.Sc.

ki, Ph.D.

WARSAW, 11.02.2015

shoots in total.

Table of contents

ble standards

9-1:2009 Instrument transformers – Part 1: General requirements

59-2:2013-06 Instrument transformers – Part 2: Additional requirements for current

2001 Current transformers. General specifications [1]

erformed

rrent test by PN-EN 61869-2:2013-06 clause 7.2.201

3 Ratings assigned by the manufacturer

Test object:	Current transformer
Type:	PA 145a
Manufacturer:	ABB Sp. z o.o., ul. Leszno 59, 06-300 Przasnysz
Serial No.:	2GKP014A1287155
Year of manufacture:	2014
Rating plate:	Figure 1, page 16
Design documentation:	1. Dimensional drawing No. 2GKA612004
	2. Drawing of current circuit No. 2GKK314159A0001
	3. Routine test report of current instrument transformer before short-time current test - type: PA 145a, No. 2GKP014A1287155; ABB Sp. z o.o., Przasnysz, 17.12.2014
	4. Routine test report of current instrument transformer after short-time current test - type: PA 145a, No. 2GKP014A1287155; ABB Sp. z o.o., Przasnysz, 30.01.2015

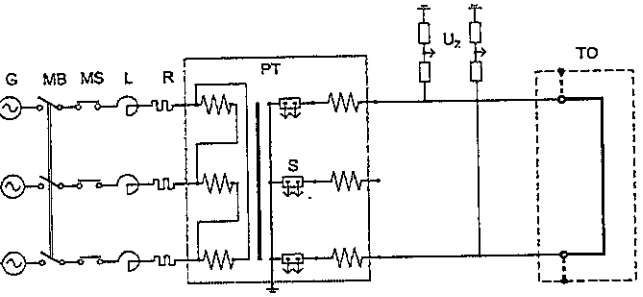
Rated primary current	I_{pr}	1500 – 3000 A
Rated continuous thermal current	I_{cth}	1800 – 3000 A
Rated frequency	f_r	50 Hz
Highest system voltage	U_m	145 kV
Rated power-frequency withstand voltage		275 kV
Rated lighting-impulse withstand voltage		650 kV
Rated short-time thermal current	I_{th}	63 – 63 kA
Rated dynamic current	I_{dyn}	158 – 158 kA
Rated duration of short circuit	t_k	1 s

Detailed list of components specified in technical project:

1. Dimensional drawing No. 2GKA612004
2. Drawing of current circuit No. 2GKK314159A0001

rent test

ing to PN-EN 61869-2:2013-06 clause. 7.2.201.



Sch. 1 Test circuit

	MB	Master Breaker	**MS**	Making Switch
	R	Resistor	**PT**	Power Transformer
urement	U_Z	Voltage Measurement	**TO**	Tested Object

.....283 MVA
.....4,5 kV
.....63 kA
.....71 mΩ
.....50 Hz

dition:
erator.....Earthed by 700 Ω
t-circuit point.....Insulated

Dynamic test at dynamic current 158 kA

Test object:.....Current transformer PA 145a

Primary current range:.....1500 A

Condition of test object before test:.....New

Date of test:.....23 January 2015 r.

Ambient temperature:.....2°C

Expected current parameters:

- Test peak current.....I_p.....158 kA
- Duration of short-circuit.....t_k.....0,06 s

Test object on testing stand:.....Phot. 1, page 15

Test results:.....Table 1, page 6, Osc. 90065, page 10

Scaling oscillogram:.....Osc. 90064, str. 9

Table 1 Test results

Oscillogram No.	90065
Symmetrical current (r.m.s)	76,6 kA
Peak value of current	161,3 kA
Duration	61,8 ms

Condition of tested object after the test:

No deterioration and failure was noted.

Test result: Object passed the test

ynamic current 100 kA

.....Current transformer PA 145a

ge: .....1500 A

ject before test:.....After dynamic test

.....23 January 2015 r.

re:.....2°C

rameters:

urrent .....I_p..... 100 kA

short-circuit.....t_k..... 0,06 s

g stand: .....Phot. 1, page 15

.....Table 2, page 7, Osc. 90066, page 11

.....Table 3, page 7, Osc. 90067, page 12

.....Table 4, page 7, Osc. 90069, page 13

.....Osc. 90064, page 9

Table 2 Test results 1

Oscillogram No.	90066
ymmetrical current (r.m.s)	48,0 kA
eak value of current	101,2 kA
uration	61,8 ms

Table 3 Test results 2

Oscillogram No.	90067
mmetrical current (r.m.s)	48,1 kA
ak value of current	101,3 kA
uration	61,3 ms

Table 4 Test results 3

Oscillogram No.	90069
mmetrical current (r.m.s)	47,6 kA
k value of current	101,39 kA
ration	81,7 ms

ject after the test:

ilure was noted.

Test result: Object passed the test

Thermal test at thermal current 63 kA

Test object: .....Current transformer PA 145a

Primary current range: .....1500 A

Condition of test object before test:.....After dynamic tests

Date of test:.....23 January 2015 r.

Ambient temperature:.....2°C

Expected current parameters:

- Test current.....I_k..... 63 kA
- Duration of short-circuit.....t_k..... 1 s

Test object on testing stand: .....Phot. 1, page 15

Test results:.....Table 5, page 8, Osc. 90071, page 14

Scaling oscillogram: .....Osc. 90064, page 9

Table 5 Test results

Oscillogram No.	90071
Symmetrical current (r.m.s)	63,2 kA
Peak value of current	124,1 kA
Voltage on primary terminals P1-P2	24,54 V
Duration	1,23 s
Integral I^2dt	4,93 GA^2s

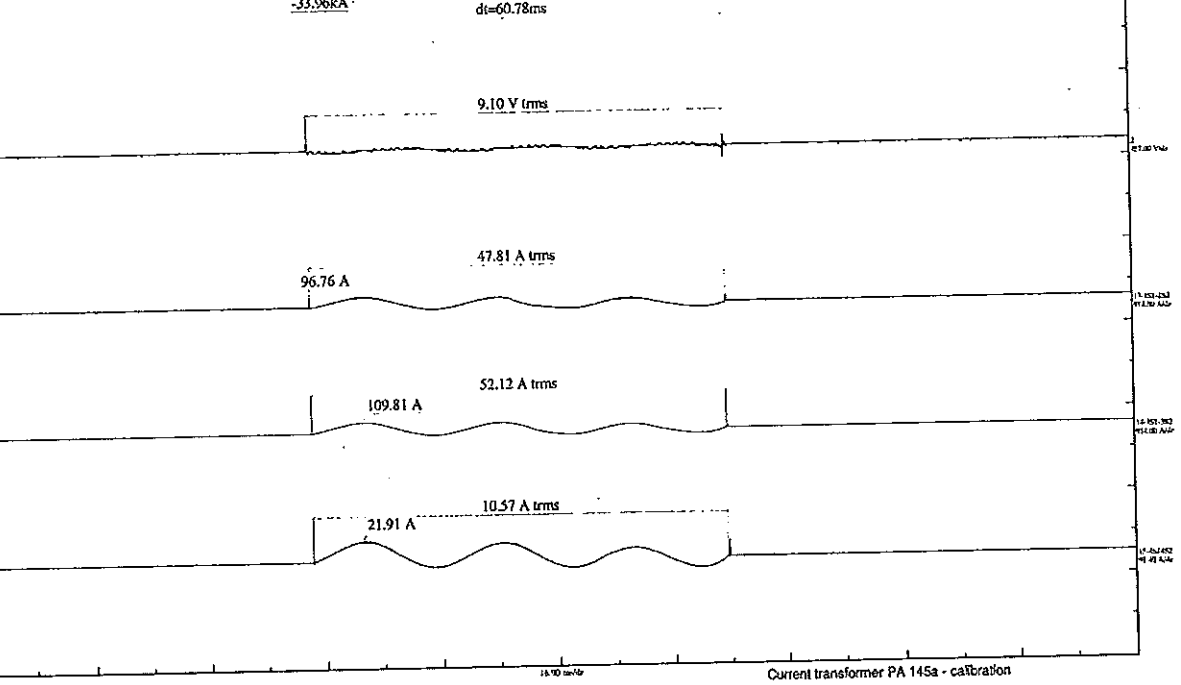
Condition of tested object after the test:

No deterioration and failure was noted.

Test result: Object passed the test

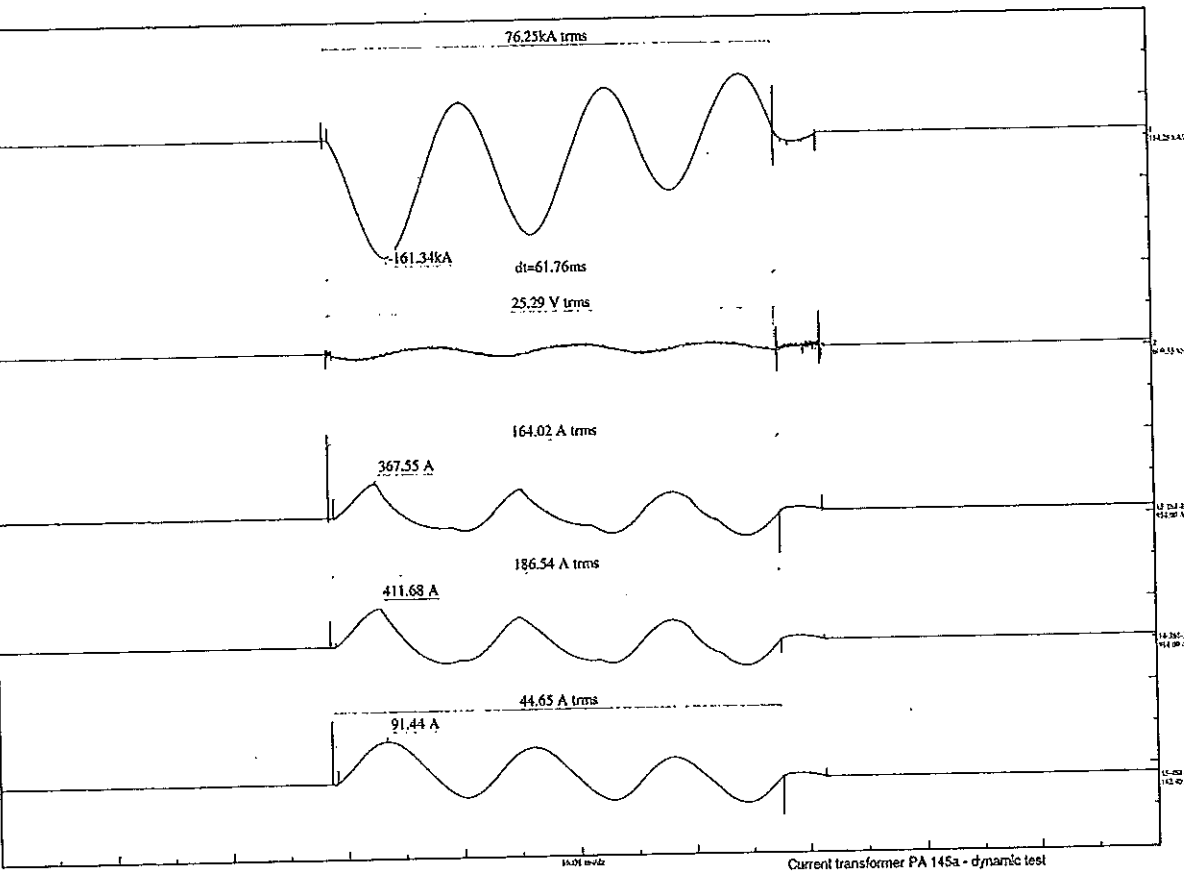
Current transformer complies with the requirements of:

- **short-time current test at thermal current 63 kA/1 s and at dynamic current 158 kA**
- **short-time current test at thermal current 40 kA/3 s and 3 dynamic tests at dynamic current 100 kA.**



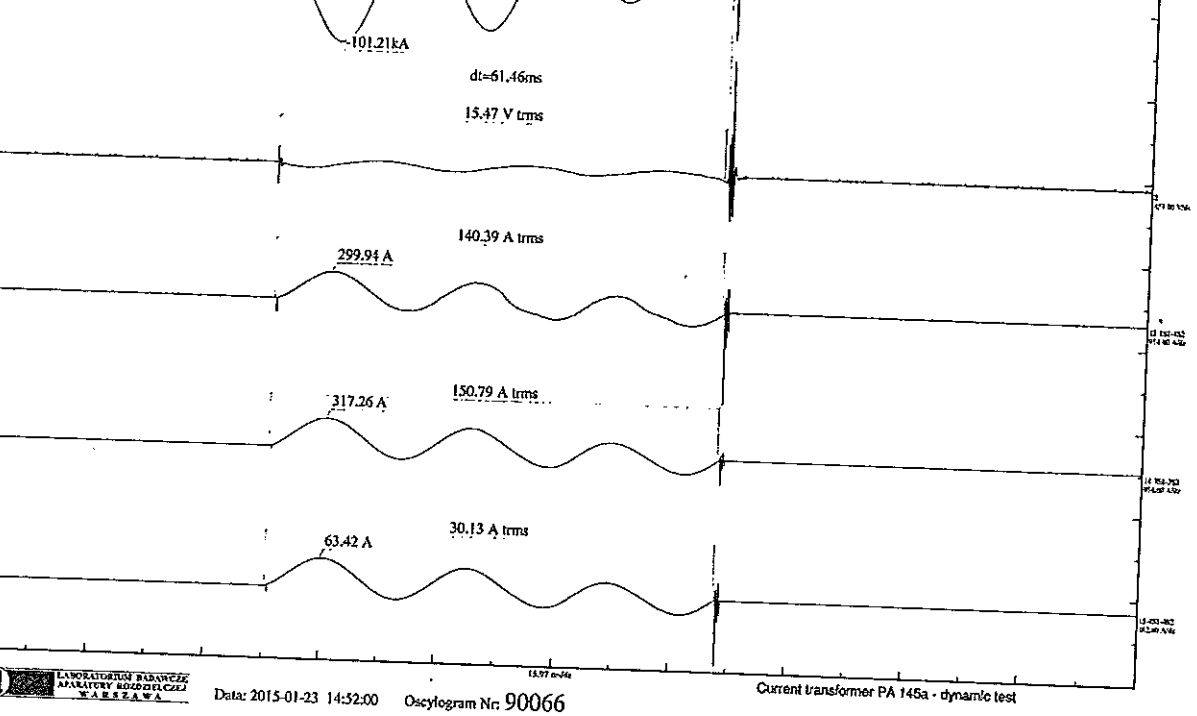
LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA

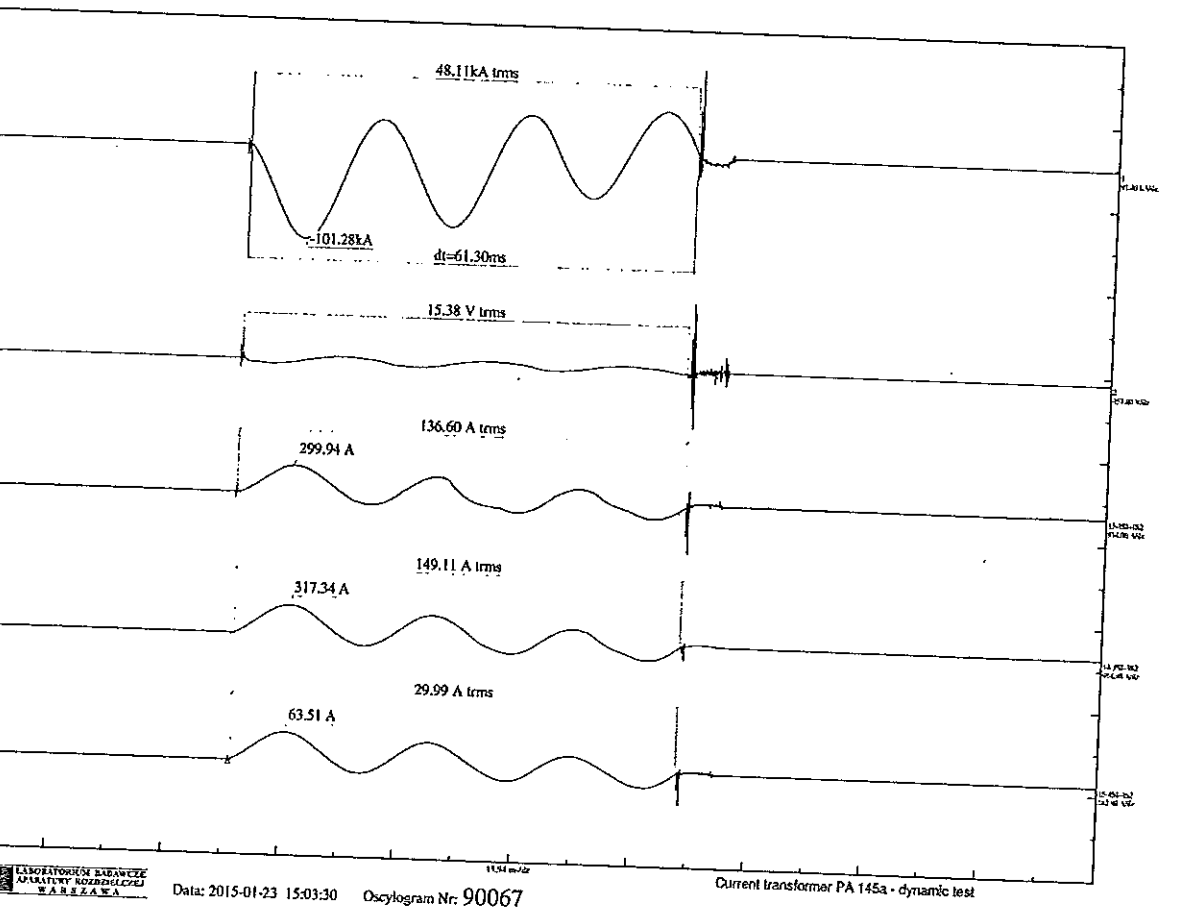
Data: 2015-01-23 14:28:34 Oscylogram Nr: 90064

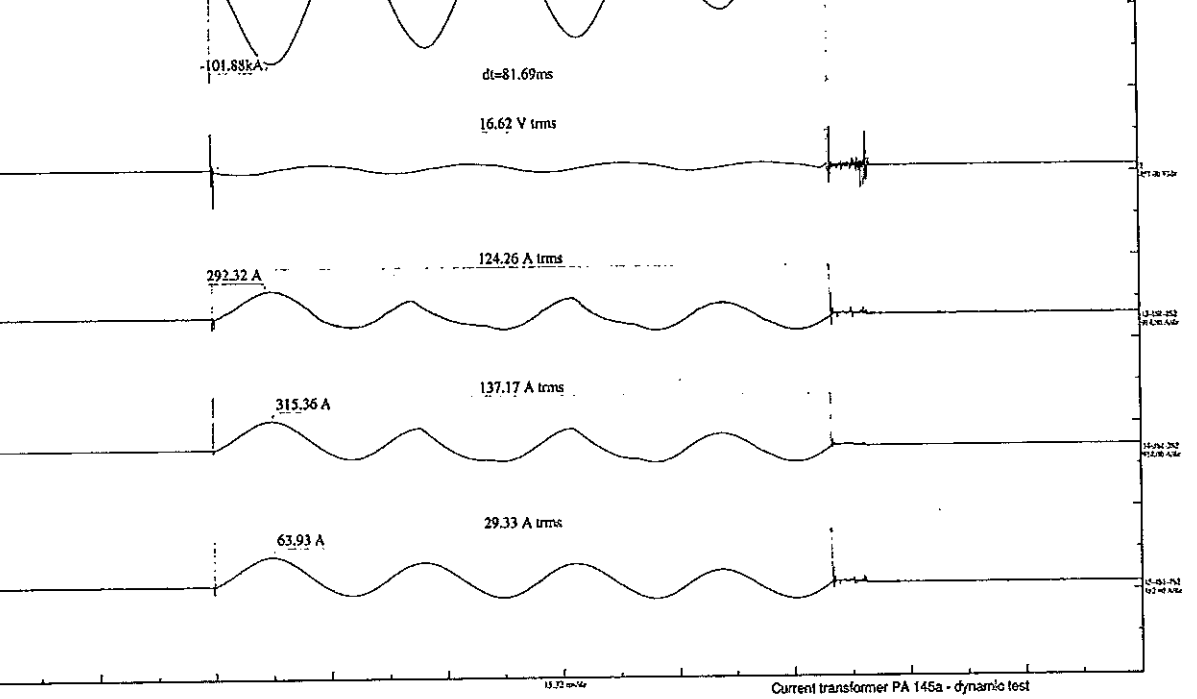


LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA

Data: 2015-01-23 14:39:04 Oscylogram Nr: 90065

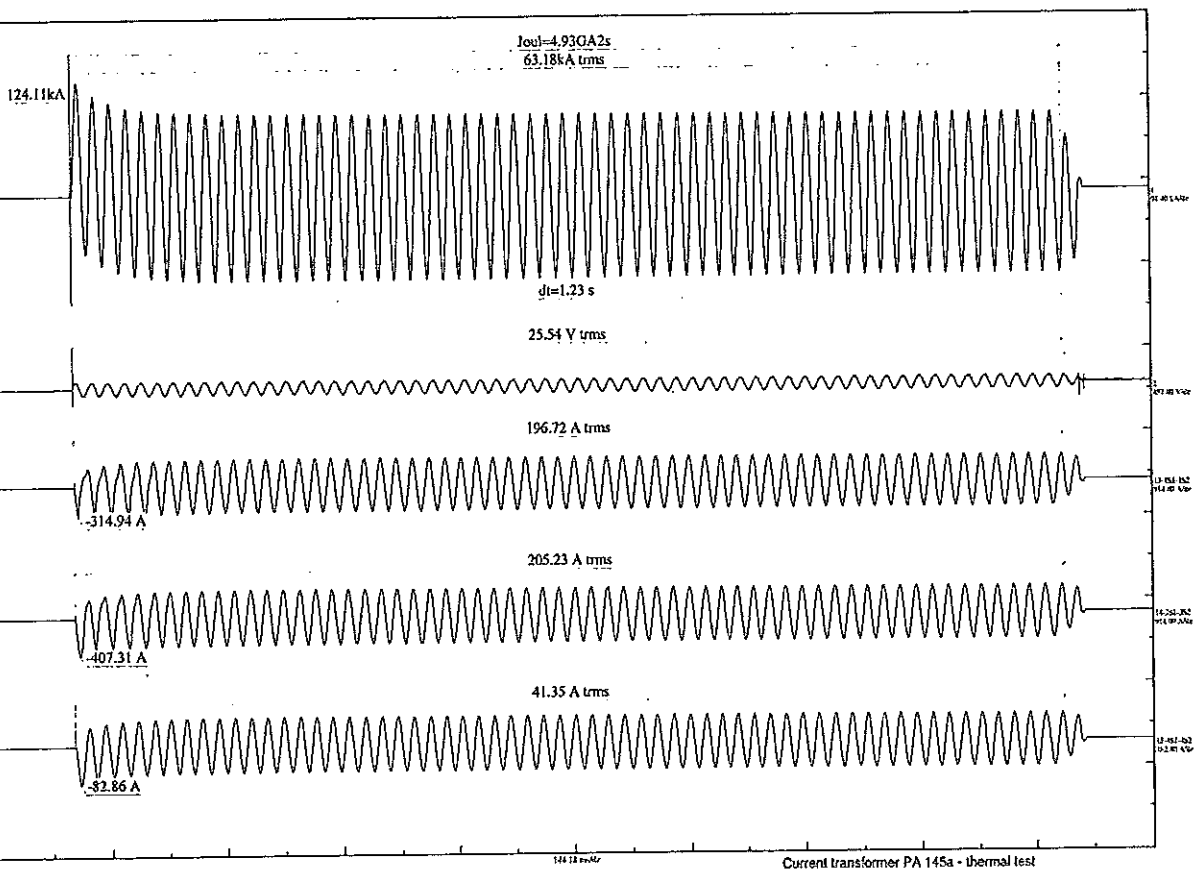

-101.21kA
dt=61.46ms
15.47 V trms
140.39 A trms
299.94 A
317.26 A
150.79 A trms
63.42 A
30.13 A trms
LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA
Data: 2015-01-23 14:52:00 Oscylogram Nr: 90066
Current transformer PA 145a - dynamic test


48.11kA trms
-101.28kA
dt=61.30ms
15.38 V trms
136.60 A trms
299.94 A
149.11 A trms
317.34 A
29.99 A trms
63.51 A
LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA
Data: 2015-01-23 15:03:30 Oscylogram Nr: 90067
Current transformer PA 145a - dynamic test



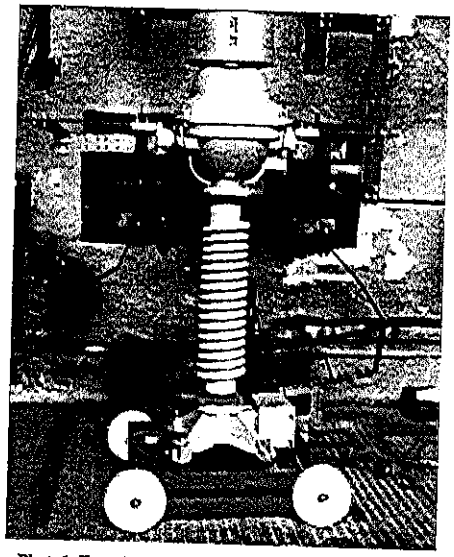
LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA

Data: 2015-01-23 15:19:52 Oscylogram Nr: 90069

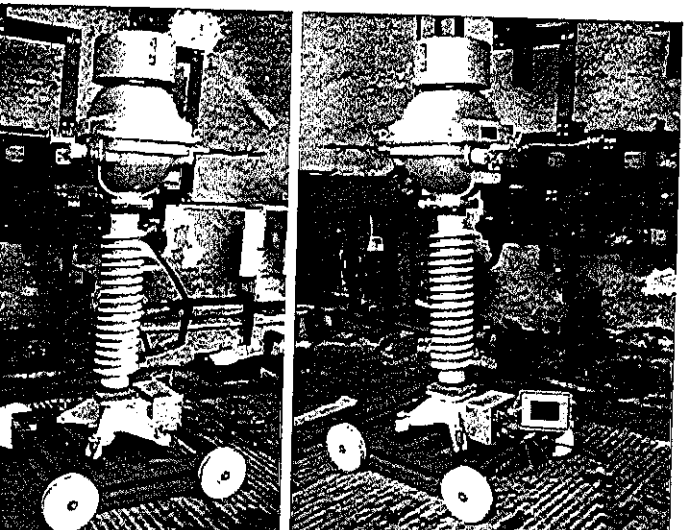


LABORATORIUM BADAWCZE APARATURY ROZDZIELCZEJ WARSZAWA

Data: 2015-01-23 15:39:30 Oscylogram Nr: 90071



Phot. 1 Test object on short-time current testing stand



6 Drawings

ABB

Current Transformer | Type: PA 145a

Insulation level: 145/275/650 kV | Standard: PN-EN 61869-2 | fn: 50 Hz

Oil type: Nytro Libra | Weight / Oil weight: 360 / 120 kg | Temp. range: -40°C ÷ +40°C

S/N: 2GKP014A1287155

K_n: 1500-3000/5-1-5-1-1 A/A

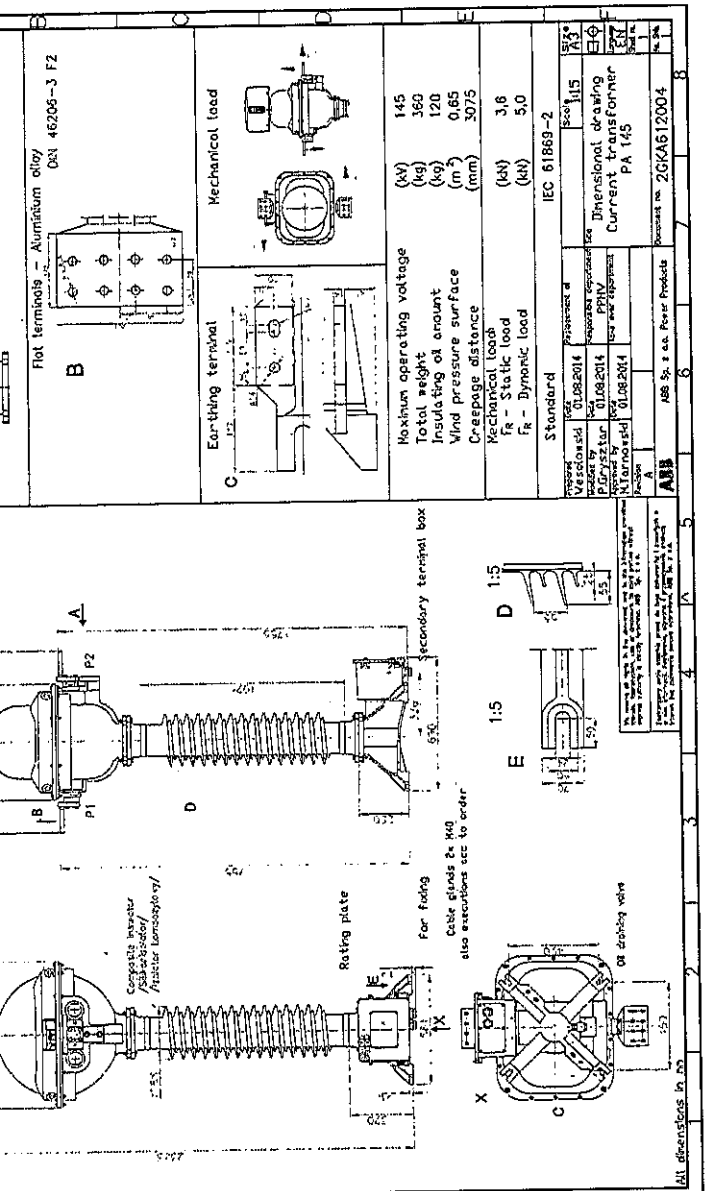
I_{th}/1s: 63-63 kA | I_{dyn}: 158-158 kA

I_{cth}: 1800-3000 A

	A	VA	Class	FS/ALF	Ext.%
1S1-1S2	5	200	0,2	10	120
2S1-2S2	1	100	0,1	5	120
3S1-3S2	5	20	5P	60	
4S1-4S2	1	35	10P	40	
5S1-5S2					
6S1-6S2					

Transportation: Vertical / Horizontal

Figure 1 Rating plate



7 Uncertainty electrical and non electrical quantities in laboratory

Measured quantity	*Range*	*Frequency*	*Measured parameter / uncertainty [%]*			
Voltage U / Divider RC	0 ≤ U ≤ 1000 V	dc - 20kHz	RMS	≤ ± 1.5	Peak	≤ ± 1.0
		> 20kHz	RMS	≤ ± 2.5	Peak	≤ ± 2.0
	1000 V ≤ U ≤ 10 kV	dc - 20kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
		> 20kHz	RMS	≤ ± 2.5	Peak	≤ ± 2.0
	U > 10 kV	50Hz - 20kHz	RMS	≤ ± 3.0	Peak	≤ ± 2.5
		> 20kHz	RMS	≤ ± 3.5	Peak	≤ ± 3.0
Current I / Shunt	0 ≤ I ≤ 100 A	dc - 5kHz	RMS	≤ ± 1.5	Peak	≤ ± 1.0
			Joule integral	≤ ± 2.0	Peak – Peak/√8	≤ ± 2.0
		> 5kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
			Joule integral	≤ ± 3.0	Peak – Peak/√8	≤ ± 3.0
	100 A≤ I ≤ 10 kA	dc - 5kHz	RMS	≤ ± 1.5	Peak	≤ ± 1.0
			Joule integral	≤ ± 2.0	Peak – Peak/√8	≤ ± 2.0
		> 5kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
			Joule integral	≤ ± 3.0	Peak – Peak/√8	≤ ± 3.0
	I > 10 kA	dc - 5kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
			Joule integral	≤ ± 3.0	Peak – Peak/√8	≤ ± 3.0
		> 5kHz	RMS	≤ ± 2.5	Peak	≤ ± 2.0
			Joule integral	≤ ± 3.5	Peak – Peak/√8	≤ ± 3.5
Current I / Current transformer	0 ≤ I ≤ 100 A	50Hz - 5kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
			Joule integral	≤ ± 2.5	Peak – Peak/√8	≤ ± 2.5
		> 5kHz	RMS	≤ ± 2.5	Peak	≤ ± 2.0
			Joule integral	≤ ± 3.0	Peak – Peak/√8	≤ ± 3.0
	100 A≤ I ≤ 10 kA	50Hz - 5kHz	RMS	≤ ± 2.0	Peak	≤ ± 1.5
			Joule integral	≤ ± 2.5	Peak – Peak/√8	≤ ± 2.5
		> 5kHz	RMS	≤ ± 2.5	Peak	≤ ± 2.0
			Joule integral	≤ ± 3.0	Peak – Peak/√8	≤ ± 3.0
	10 kA ≤ I ≤ 30 kA	50Hz - 5kHz	RMS	≤ ± 3.0	Peak	≤ ± 2.5
			Joule integral	≤ ± 3.5	Peak – Peak/√8	≤ ± 3.5
		> 5kHz	RMS	≤ ± 3.5	Peak	≤ ± 3.0
			Joule integral	≤ ± 4.0	Peak – Peak/√8	≤ ± 3.5

Resistance R *bridge, multimeter*	20 µΩ≤ R ≤ 600 µΩ	≤ ± 5 %
	0.6 mΩ≤ R ≤ 600 mΩ	≤ ± 3 %
	0.6 Ω ≤ R ≤ 100 MΩ	≤ ± 1 %
Frequency f *oscilloscope, recorder TR*	≤ 10 kHz	≤ ± 0.2 %
	10 kHz ≤ f ≤ 1 Mhz	≤ ± 0.5 %
Time t *oscilloscope, recorder TR*	≤ 1 µs	≤ ± 20 %
	1 µs≤ t ≤ 1 ms	≤ ± 10 %
	> 1 ms	≤ ± 10%
Temperature T thermocouples	-50 °C≤ t ≤ 100 °C	≤ ± 0.2°C - *thermometer*
	-100 °C≤ t ≤ 200 °C	≤ ± 0.8 °C - *thermocouples K, recorder*
Relative humidity	20 % do 90% RH	≤ ± 5 % RH
Length Lengthmeter	≤1 mm	≤ ± 0.05 mm
	1 mm≤ l ≤30 mm	≤ ± 0.1 mm
	>30 mm	≤ ± 5 %
Gas pressure p	≤ 20 bar	≤ ± 5 %
	20 bar ≤ p ≤ 200 bar	≤ ± 10 %

utine test report of current instrument transformer before short-time current test

Sp. z o.o. Przasnysz eszno 59	Routine test report of current instrument transformer	TYPE: PA145a Serial no: 2GKP014A1287155	
Idyn [kA]: 158-158	Ith [A]: 1800-3600	PN-EN 61869-2	50 Hz

	Isn [A]	Sn [VA]	class	Ratio [A/A]
	5	200	0,2FS 10	1500-3000/5
	1	100	0,1FS 5	1500-3000/1
	5	20	5P 60	1500-3000/5
	1	35	10P 40	1500-3000/1

ests:

rameters check before filling (oil after treatment): ☑
60247, breakdown voltage acc. IEC 60156 ☑
rminal markings ☑
htness test: oil overpressure: 0,8 bar / 24h – no traces of oil leakage ☑
y withstand test
g
measurement - P1+P2: Up = 230kV / 60s, f = 50Hz ☑
y withstand test on secondary windings ☑
ltage test - Up = 3 kV/60s, f=50Hz ☑
errors - lower value (U peak=4,5kV or U peak for Ith) / ☑
the over current factors: FS, ALF ☑
capacitance and dielectric dissipation factor - tgδ ☑
core magnetization characteristics ☑
vindings' resistance ☑

ters check before filling (oil after treatment)

g δ according to IEC
; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C

kdown voltage according to IEC 60156
oltage = 76.27 kV, Relative standard deviation = 5.87
= 25.4 °C, measurement without the stirrer, type of electrodes used: partially spherical.

down voltage [kV]
77.7
77.9
72.7
83.2
70.4
75.7

Partial discharge measurement

- Measurement according to procedure A (PD test voltages were reached while decreasing the voltage after the power-frequency withstand test on primary winding)

Stress voltage: 275 kV / 60 s
Frequency: 50 Hz

Test voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100.5 k
Level of partial discharge	1 pC	0.9 pC

Remarks: background noise level: 0.7 (measured after voltage switch off),
measuring circuit was calibrated with 5 pC (calibrating

Inter-turn overvoltage test

Winding	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
1S1-1S2	4.5	1450
2S1-2S2	4.5	350
3S1-3S2	4.5	1000
4S1-4S2	3.24	3600

Determination of errors ε I (%), Δφ I min)

Ipn (A): 1500

1S1-1S2: 200 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	-0.313	-0.147	-0.042	-0.032
Δφ I	6.3	3.1	1.0	0.7

2S1-2S2: 100 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	-0.058	-0.039	-0.003	-0.003
Δφ I	1.3	0.3	-0.5	-0.4

3S1-3S2: 20 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.016	
Δφ I	0.3	

ε I	
Δφ I	

1S1-1S2: 50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	-0.056	0.046	0.089	0.092
Δφ I	3.9	1.8	0.9	0.8

2S1-2S2: 25 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	0.015	0.014	0.017	0.018
Δφ I	0.3	0.2	0.0	0.0

4S1-4S2: 35 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-1.323	
Δφ I	63.5	

Ipn (A): 3000

1S1-1S2: 200 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	-	-	-0.043	-
Δφ I	-	-	1.0	-

Measurements uncertainty: $\varepsilon_I = \pm 0{,}045\ \%$, $\Delta\varphi_I = \pm 2{,}3$ min

Determination of the over current factors:

- instrument security factor (FS) of measuring cores

Winding	Io [A]	U [V]	E_{FS} [V]	Condition	Assessment
1S1-1S2	5	233.67	422.08	U < E_{FS}	☑
2S1-2S2	0.5	227	526.03	U < E_{FS}	☑

factor (ALF) – test for composite error ε_c of protective cores

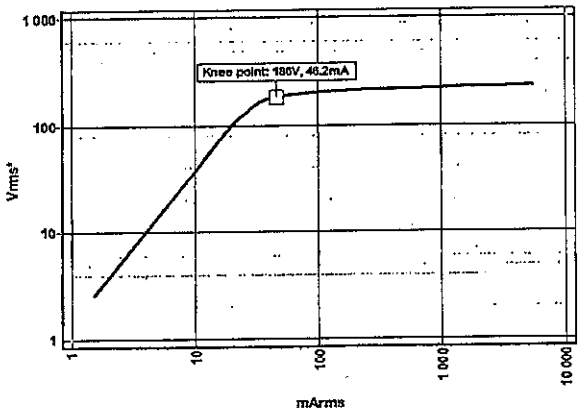
E_{ALF} [V]	Ie [A]	ε_c [%]	Condition	Assessment
430.12	0.047	0.02	$\varepsilon_c \leq 5\%$	☑
1625.98	0.898	2.25	$\varepsilon_c \leq 10\%$	☑
	0.242		$\varepsilon_c \leq$	

acitance and dielectric dissipation factor - tg δ
requency: 50

Tg δ	Capacitance	Leak.current
[%]	[pF]	[mA]
0.24	1124	3.575
0.24	1125	26.87
0.24	1125	29.73

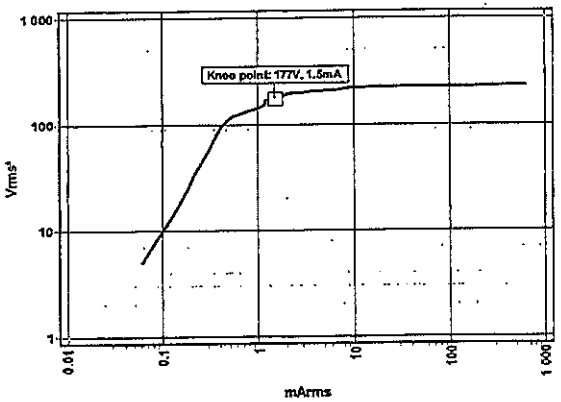
haractoristics:

]
.7
.1
.1
9
33
3
7
7
8
6
7
1
7
6



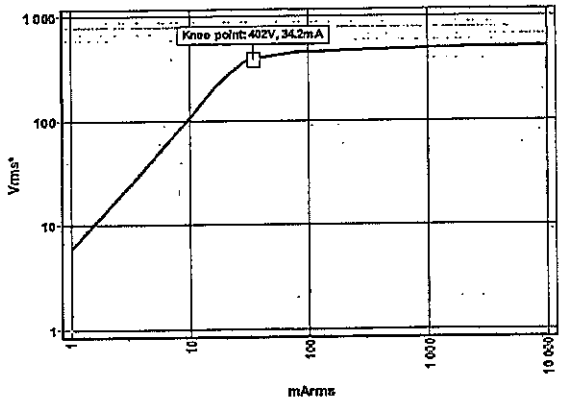
Winding 2S1-2S2

[V]	[mA]
228.5	645.1
205.2	3.9
191.8	2.07
186.3	1.89
183	1.77
179.4	1.63
176	1.43
172.8	1.35
169.3	1.21
162.7	1.55
133.6	0.77
102.3	0.44
67.3	0.33
32	0.21
5	0.08

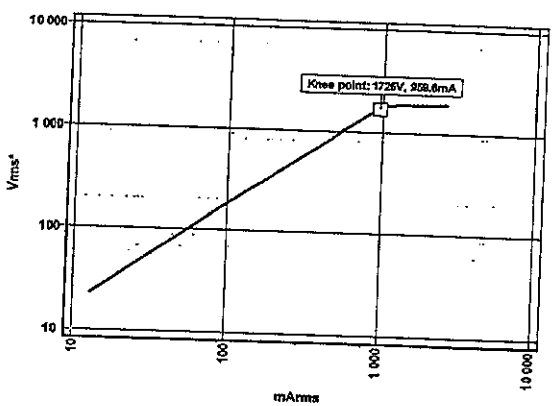


Winding 3S1-3S2

[V]	[mA]
525.1	9728
523.8	8209
520.3	4990.4
518.7	3801.5
506.4	1070.4
474.3	140.39
459.1	78.03
442.6	53.68
404.7	34.65
368	28.14
330.8	24.68
293.8	21.8
182.3	14.74
69.5	7.21
5.8	1.01



[mA]
612.2
2155
669.8
321.3
068.3
020.7
88.8
932
32.1
748
60
8.29
9.63
4.7
.23



*) Average rectifier effective value.

dings' resistance

	R (23 °C)	Rct (75 °C)
A	63.0 μΩ	75.9 μΩ
A	26.0 μΩ	31.3 μΩ
	0.452 Ω	0.545 Ω
	5.330 Ω	6.419 Ω
	0.590 Ω	0.711 Ω
	5.650 Ω	6.805 Ω

OG-1 KJ-21

Przasnysz,

9 Annex B – Routine test report of current instrument transformer after short-time current test

ABB Sp. z o.o. 06-300 Przasnysz ul. Leszno 59	Routine test report of current instrument transformer After short time current test		TYPE: PA145a Serial no: 2GKP014A1287155	
Ith 1s [kA]: 63-63	Idyn [kA]: 158-158	Icth [A]: 1800-3600	PN-EN 61869-2	50 Hz

Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
1S1-1S2	5	200	0,2FS 10	1500-3000/5
2S1-2S2	1	100	0,1FS 5	1500-3000/1
3S1-3S2	5	20	5P 60	1500-3000/5
4S1-4S2	1	35	10P 40	1500-3000/1

List of performed tests:

1. Oil dielectric parameters check before filling (oil after treatment): tg δ acc. IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil leakage ☑
4. Power-frequency withstand on primary winding - P1+P2: Up = 247,5kV / 60s, f = 50Hz ☑
5. Partial discharge ☑
6. Power-frequency withstand test on secondary ☑
7. Inter-turn overvoltage - Up = 3 kV/60s, f=50Hz ☑
8. Determination of errors - lower value (U peak=4,5kV or U peak for Icth) / 60s ☑
9. Determination of the over current factors: FS, ALF ☑
10. Measurement of capacitance and dielectric dissipation factor - tgδ ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tg δ according to IEC
  Tg δ = 0.1983 %; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage = 76.27 kV, Relative standard deviation = 5.87
  f = 50Hz, oil temp. = 25.4 °C, measurement without the stirrer, type of electrodes used: partially spherical.

Sample	Breakdown voltage [kV]
1	77.7
2	77.9
3	72.7
4	83.2
5	70.4
6	75.7

asurement

rding to procedure B

7,5 kV / 60 s

oltage	1,2 Um = 174 kV	1,2 Um / √3 = 100.5 k
al discharge	1.1 pC	1 pC

d noise level: 0.7 (measured after voltage switch off),
s calibrated with 5 pC (calibrating

e test

Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
4.5	1450
4.5	350
4.5	990
3.19	3600

rrors ε I %), Δφ I min)

		p.f. = 0,8 lag.
0,2 In	1,0 In	1,2 In
-0.148	-0.043	-0.033
3.0	0.9	0.7

		p.f. = 0,8 lag.
0,2 In	1,0 In	1,2 In
-0.043	-0.003	-0.007
0.4	-0.6	-0.3

		p.f. = 0,8 lag.

		p.f. = 1

1S1-1S2: 50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	-0,041	0,045	0,088	0,091
Δφ I	3.9	1.7	0.9	0.8

2S1-2S2: 25 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,2 In
ε I	0.014	0.011	0.012	0.010
Δφ I	0.3	0.3	0.2	0.3

4S1-4S2: 35 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-1.328	
Δφ I	63.2	

		p.f. = 0,8 lag.
0,2 In	1,0 In	1,2 In
-	-0.044	-
-	1.0	-

tainty: ε I = ± 0,045 %, Δφ I = ± 2,3 min

over current factors:

curity factor (FS) of measuring cores

Ie [A]	U [V]	EFS [V]	Condition	Assessment
5	233.75	422.57	U < EFS	☑
0.5	227	526.81	U < EFS	☑

- accuracy limit factor (ALF) – test for composite error ε c of protective cores

Winding	EALF [V]	Ie [A]	εc [%]	Condition	Assessment
3S1-3S2	430.4	0.047	0.02	εc ≤ 5%	☑
4S1-4S2	1626.33	0.898	2.24	εc ≤ 10%	☑

Measurement of capacitance and dielectric dissipation factor - tg δ

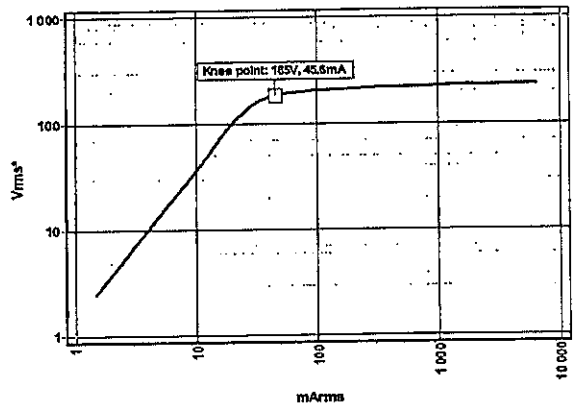
Temperature: 22.6 °C, Frequency: 50

Primary voltage	Tg δ [%]	Capacitance [pF]	Leak.current [mA]
10 kV	0.24	1127	3.592
76 kV	0.24	1128	26.9
84 kV	0.24	1128	29.78

Core magnetization characteristics:

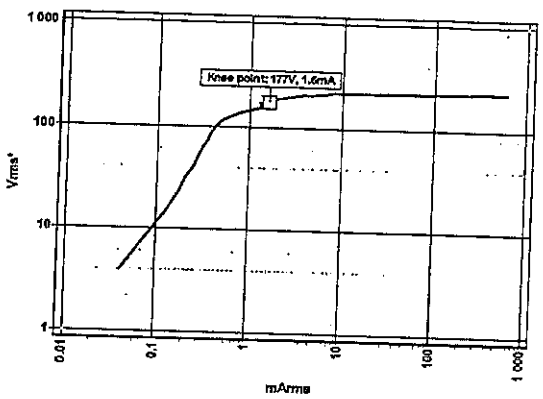
Winding 1S1-1S2

[V]	[mA]
234.6	6267
233.4	4558
231.2	2625.9
227.9	1511.7
216.5	321.59
208.8	133.29
203.6	90.26
184.7	44.86
166	33.81
147.4	28.67
128.7	25.04
91	18.62
53.6	12.97
16	5.53
2.4	1.5

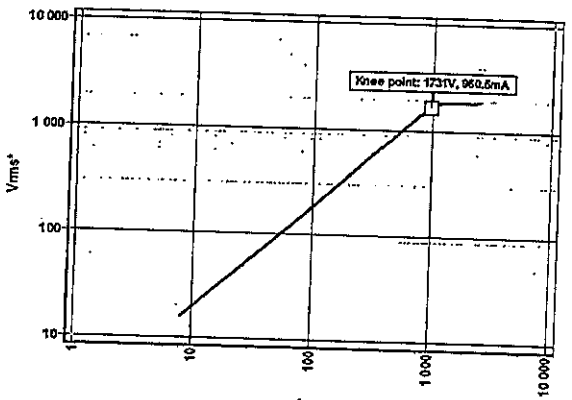


2

[mA]
610.7
3.78
2.08
2
1.84
1.69
1.55
1.47
1.31
1.63
0.73
9.42
9.32
0.2
.04



nA]
26.7
19.7
21.3
77
0.6
8.2
2.7
9.3
9.7
7.1
7.8
35
91
27
2



*) Average rectifier effective value.

lings' resistance

	R (22 °C)	Rct (75 °C)
	63.0 µΩ	76.1 µΩ
	26.0 µΩ	31.4 µΩ

1S1-1S2	0.460 Ω	0.555 Ω
2S1-2S2	5.470 Ω	6.609 Ω
3S1-3S2	0.589 Ω	0.712 Ω
4S1-4S2	5.640 Ω	6.815 Ω
5S1-5S2	6.120 Ω	7.395 Ω

Checked by: GoiN OG-4 KJ-21

Przasnysz, 2015-01-30

INSTITUTE OF POWER ENGINEERING
DISTRIBUTION EQUIPMENT LABORATORY

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TEST REPORT No. EUR/71/E/13-4 E

: Combined instrument transformer type PVA 145a with composite insulator
Serial No. 2GKP013K1486145/13

RER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

RED BY: Internal order No. EWN/145/E/13 dated 12.12.2013

TS: Short-time current tests
Test for composite error

EDURE: According to IEC 61869-2:2012

TS: 18/19.12.2013

LT: Positive for
$I_{dyn} = 50$ kA, $I_{th} = 20$ kA, t = 1 s for 150 A terminal

Tests result refers only to the test object

VERE BY: Z. Wesołowski – ABB Sp. z o.o.

ngineer

HEAD OF LABORATORY

Lidia Gruza

Warsaw, 15.01.2014

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figures	2
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BJECT

escription

ned instrument transformer type PVA 145a is used for supplying of measuring and cuits in the network of maximum operating voltage 145 kV and frequency 50 Hz. The onsists of current and voltage transformers mounted in common housing with ulator immersed with transformer oil.

chnical data

anufacturer attributed the following construction data to the test object.

rating voltage	145 kV
cy	50 Hz
ous thermal current	180 A, 360 A
ne current for 1 s	20 kA
current	50 kA

chnical documentation

ose of tests the orderer delivered the following technical documentation:
drawing combined transformer PVA 123a-145a, No. 2GKK614123 (17.12.2013),
eport of combined instrument transformer (04.12.2013),
eport of combined instrument transformer after short-time current test (03.01.2014),

nsformer electrical diagram
B Sp. z o.o (Annex 3 and 4).
proceeded the identification of test object on the base of above documentation and Conformity of manufacturing with constructional documentation is stated 's declaration, copy of which presents Annex 4.

paration for tests

t was prepared for tests in the factory by the manufacturer.

F TESTS

agreed with orderer, comprised the following tests according to requirements of 12:

rrent tests of current transformer acc. to item 7.2.201 of above standard at

0 kA, I_{th} = 20 kA, t_{th} = 1 s, $I_{th}^2 \times t_{th} \geq 400$ kA^2×s for 150 A terminal.

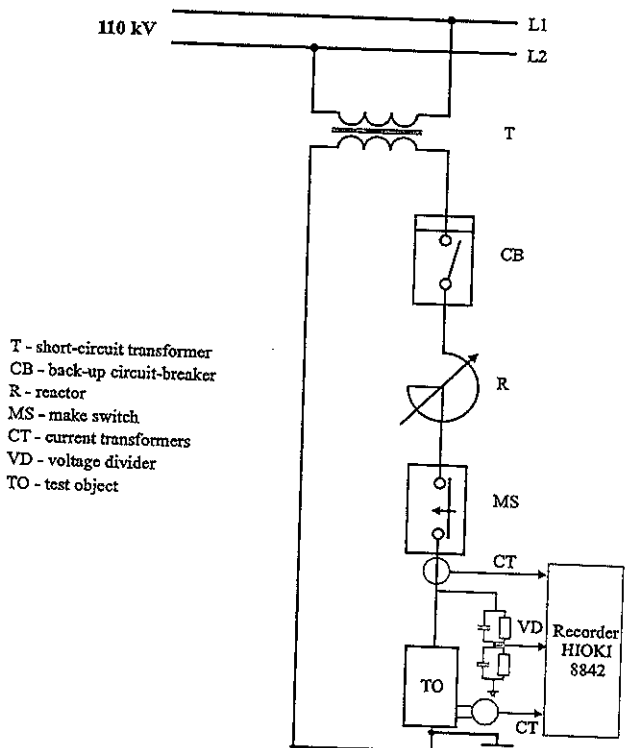
ite error acc. to item 7.2.6.203 of above standard with current's transformer burden connected to 3S1-3S2 windings at parameters:
,3 kA, t_{th} = 1 s for 150 A terminal,

ore and after short-time current test made in factory.

3. TEST AND MEASURING CIRCUITS

For the tests the transformer was fixed to the rigid construction of the test stand. Short-time current tests and test for composite error were made in one-phase circuit presented on fig. 1 at dimensions presented on fig.2.
The following quantities were recorded during the tests using digital recorder type HIOKI 8842:

- primary current (with short-circuited all secondary terminals) during short-time current tests using laboratory current transformer type CdC class 0,5 with a ratio 50.000/2 A/A (uncertainty of measurement ±0,018% for k = 2),
- secondary currents in 1S1-1S2, 3S1-3S2, 4S1-4S2 windings by means of laboratory toroidal current transformers type IL20a class 0,5 with a ratio 1.000/5 A/A and 2.000/5 A/A (uncertainty of measurement ±0,012% for k = 2),
- voltage drop (U_o) on test object during short-time current tests by means of a resistance-capacitance voltage divider with a bandwidth from 0 to 100 kHz.



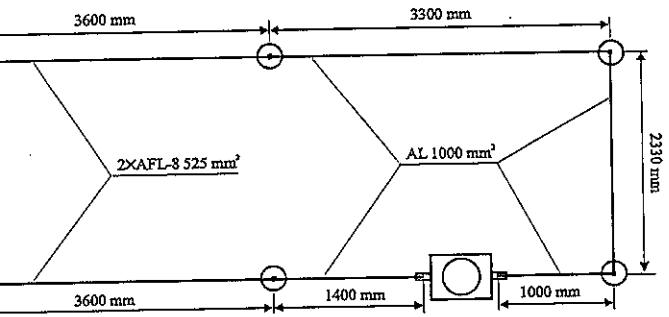


Fig. 2. Configuration of test circuit during tests

D THEIRS DETAILED RESULTS

lts presents tables 1 and 2.
e tests the following records were made:
Nos. 33101, 33104 – calibration of measuring and test circuit,
Nos. 33102, 33103 – short-time current tests,
No. 33105 – composite error test,
(Annex 1 presents the copies of short-circuit test records - all records are stored in laboratory's archives),
hot. 1 – current transformer on short-circuit tests stand
(Annex 2 presents the photograph).

of short-time current tests

I_z	t_z	$I_z^2 \times t_z$	$I_{1S1-1S2}$	$I_{3S1-3S2}$	$I_{4S1-4S2}$	U_0	Observations
A	s	$(kA)^2 \times s$	A	A	A	V	-
,31	0,06	–	–	–	–	–	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
,31	1,02	420,7[2)]	232*	618	127	201	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

of test current,
e of test current (determined from test period without asymmetrical component),
n,
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component),
e (determined from test period without asymmetrical component).
≥ 50 kA,

During the composite error test current's transformer burden connected to 3S1-3S2 was 2,4 Ω.

Table 2. Results of composite error test for 3S1-3S2 winding

Test No.	I_p	ε_c	t_z	Observations
-	kA	%	s	-
33105	3,02	0,71	1,00	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

Legend:
I_p – r.m.s. value of the test current (determined from test period without asymmetrical component),
t_z – test duration,

$$\varepsilon_c = \frac{\sqrt{\frac{1}{T}\int_0^T (k_r \cdot i_s - i_p)^2 dt}}{I_p} \cdot 100\%$$

k_r – rated transformation ratio (150/5 A/A),
i_p – instantaneous value of the primary current,
i_s – instantaneous value of the secondary current,
T – duration of one cycle.

5. TESTS RESULTS EVALUATION

According to criteria given in IEC 61869-2:2012 the results of tests is positive for:

I_{dyn} = 50 kA, I_{th} = 20 kA, t = 1 s for 150 A terminal of tested combined instrument transformer.

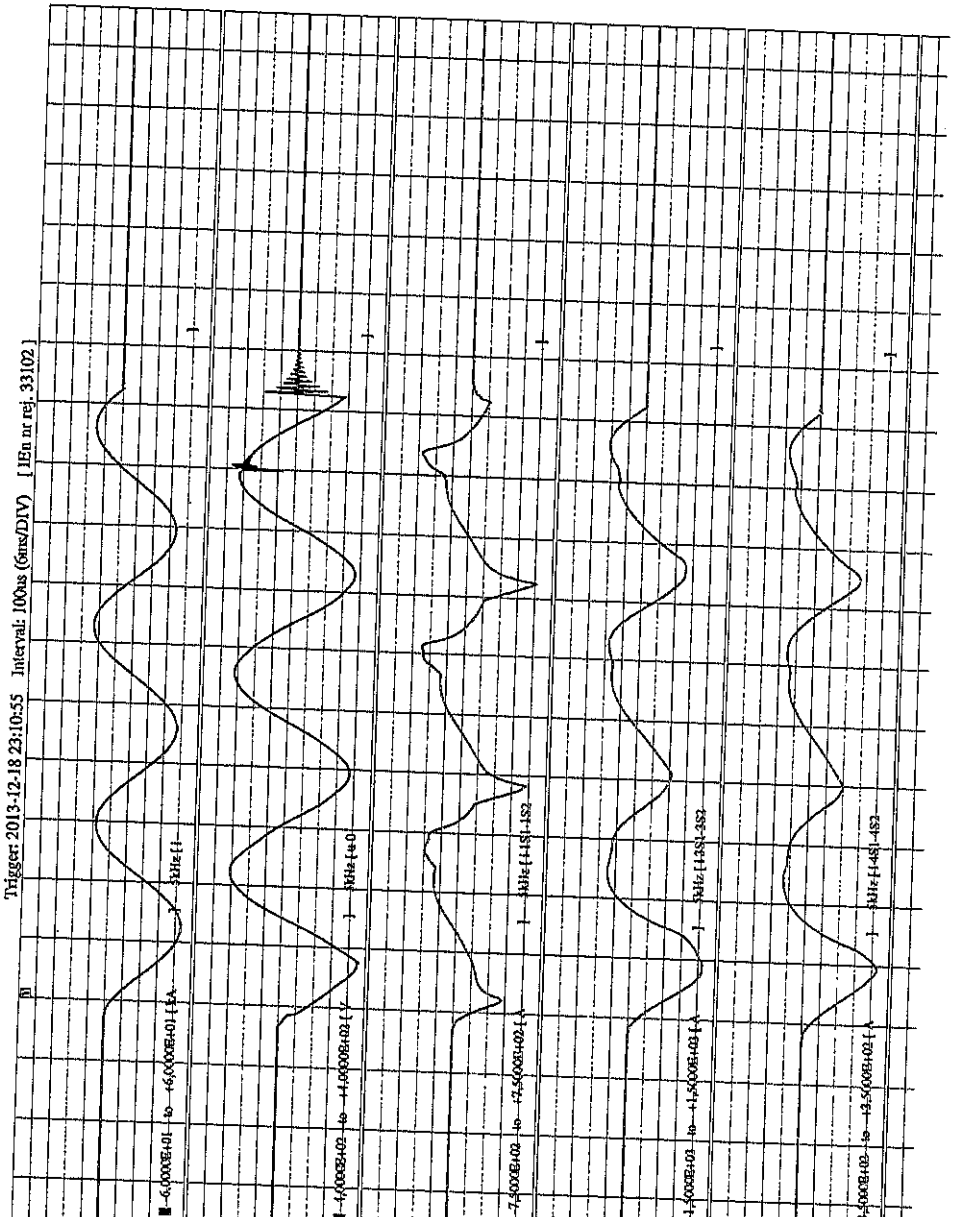
Test records

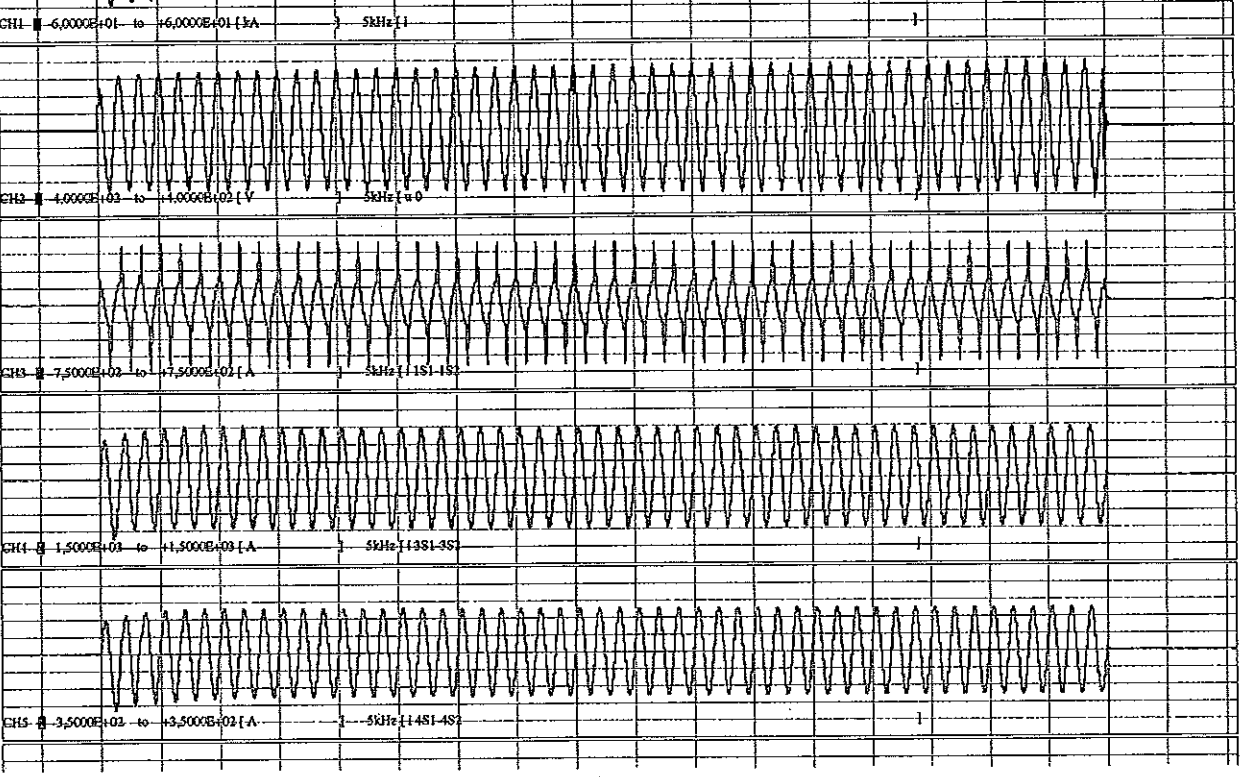
As not numbered pages the following copies of records are given:

33102, 33103 – short-time current tests,
33105 – composite error test.

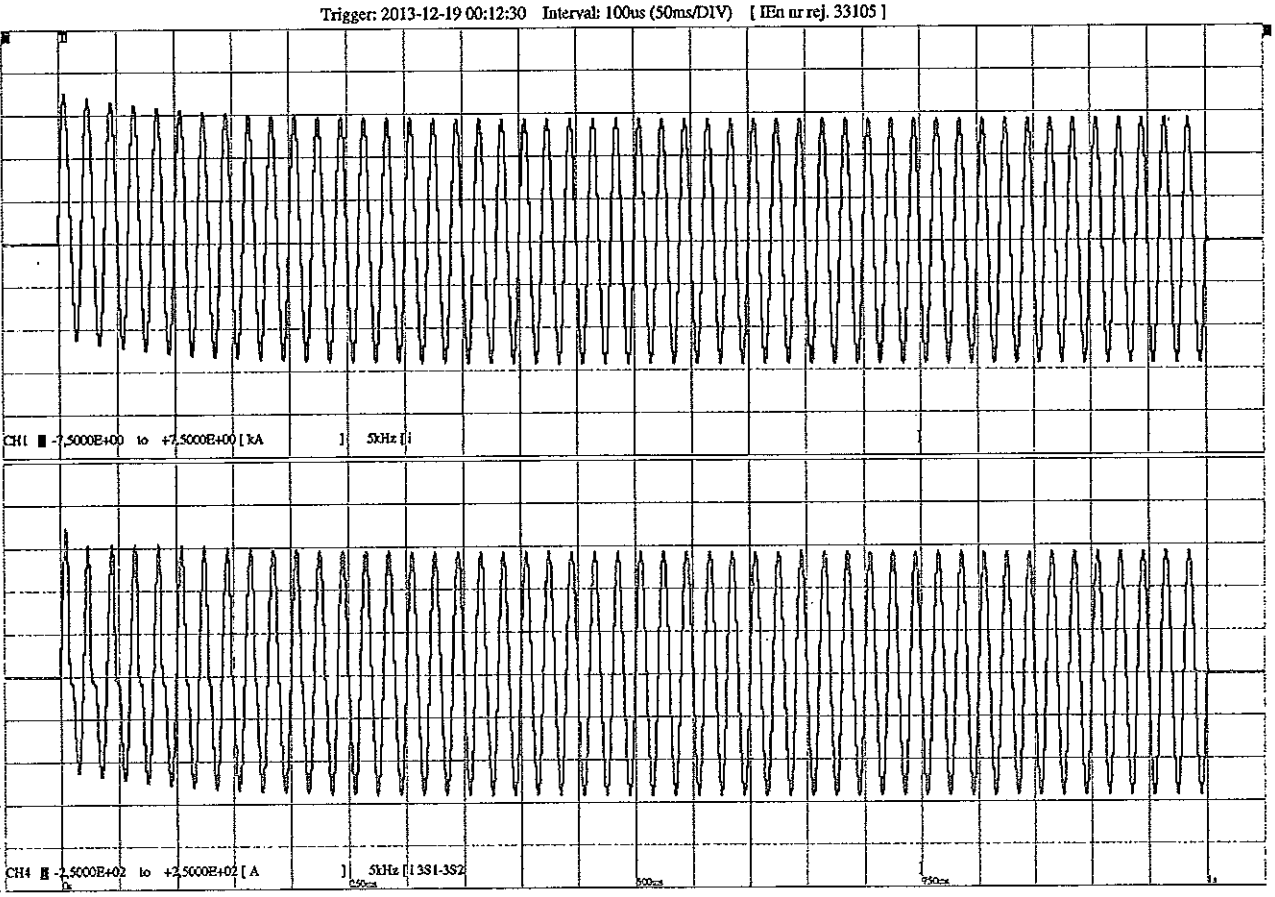
ions:

p on test object,
2 winding current,
2 winding current,
2 winding current.

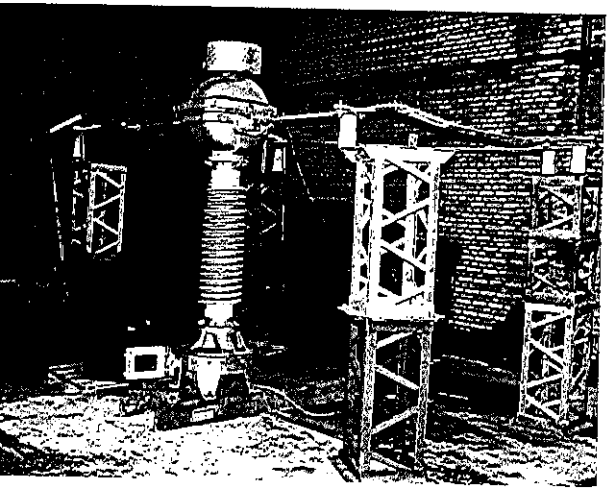




Trigger: 2013-12-19 00:12:30 Interval: 100us (50ms/DIV) [IEn nr rej. 33105]



Photographs taken during the tests



Phot. 1. PVA 145a after short-time current tests

ANNEX 3 Routine test report before and after short-time current tests

ABB Sp. z o.o. 06-300 Przasnysz ul. Leszno 59		Routine tests report of combined instrument transformer			TYPE: PVA145a Serial no: 2GKP013K1486145	
A-N	Insulation level:	Voltage factor:	Ith 1s [kA]:	Idyn [kA]:	Icth [A]:	IEC 61869-4
132:√3 kV	145/275/650 kV	1.9/8h	20-20	50-50	225-450	50 Hz

VOLTAGE PART	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a - 1n	0,11:√3	100	1,0	1000
	2a - 2n	0,11:√3	100	1,0	1000
	3a - 3n	0,11:√3	100	1/3P	1000
	4a - 4n	0,11:√3	100	3/3P	1000
	da - dn	0,11:3	200	3,0	460

CURRENT PART	Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
	1S1-1S2	5	30	0,2FS 5	150-300/5
	2S1-2S2	1	40	5P 20	150-300/1
	3S1-3S2	5	60	5P 20	150-300/5
	4S1-4S2	1	60	5P 20	150-300/1

List of performed tests:

1. Oil dielectric parameters check before filling (oil after treatment): tg δ acc. IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil ☑
4. Power-frequency withstand on primary windings – P1+P2/A: Up = 275kV / 60s, f = 97Hz; N: Up = 3kV / 60s, f = 50Hz ☑
5. Partial discharge ☑
6. Power-frequency withstand test on secondary – Up = 3 kV/60s ☑
7. Inter-turn overvoltage test for current transformers – lower value (U peak=4,5kV or U peak for Icth) / 60s ☑
8. Determination of errors ☑
9. Determination of the over current factors: FS, ☑
10. Measurement of capacitance and dielectric dissipation factor - tg δ ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tg δ according to IEC
  Tg δ = 0.06 %; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage = 78.15 kV, Relative standard deviation = 5.99
  f = 50Hz, oil temp. = 25 °C, measurement with the stirrer, type of electrodes used: partially

Sample	Breakdown voltage [kV]
1	73.7
2	84.3
3	82.8
4	78.4
5	76.9
6	72.8

rge measurement

nt according to procedure A (PD test voltages were reached while decreasing the
er-frequency withstand test on primary
age: 275 kV / 60 s
: 97 Hz

Test voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100.5
of partial discharge	2 pC	1.2 pC

ackground noise level: 1 (measured after voltage switch off),
ircuit was calibrated with 5 pC (calibrating

rvoltage test for current transformers

	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
	0.368	450
	4.29	450
	1.09	450
	4.5	310

on of voltage part errors (ε U%), Δφ U min)

A p.f. = 0,8 lag.
3a-3n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

n	1,0 Un	1,2 Un
4	-0.162	-0.162
3	-1.3	-1.3

3a-3n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

Un	1,0 Un	1,2 Un
7	-0.016	-0.016
3	-1.3	-1.3

A p.f. = 0,8 lag.
3a-3n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

Un	1,0 Un	1,2 Un
53	-0,162	-0,162
.1	-1.1	-1.1

3a-3n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

Un	1,0 Un	1,2 Un
7	-0.015	-0.015
3	-1.3	-1.3

A p.f. = 0,8 lag.
2a-2n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

n	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
4	-0.251	-0.150	-0.148	-0.149	-0.314
1	-1.2	-0.8	-0.8	-0.8	-4.2

2a-2n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

n	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
3	-0.102	-0.004	-0.003	-0.003	-0.170
5	-1.5	-1.1	-1.1	-1.1	-4.6

A p.f. = 0,8 lag.
2a-2n: 100VA; 3a-3n: 100VA p.f. = 0,8 lag.

n	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
1	-0.261	-0.153	-0.152	-0.152	-0.329
0	-0.0	0.4	0.4	0.4	-3.1

1a-1n: 100 VA p.f. = 0,8 lag.
2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.116	0.117	0.118
Δφ U	5.1	5.2	5.2

1a-1n: 25 VA p.f. = 0,8 lag.
2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.263	0.265	0.265
Δφ U	5.1	5.1	5.2

2a-2n: 100 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.118	0.119	0.119
Δφ U	5.3	5.3	5.4

2a-2n: 25 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.266	0.267	0.267
Δφ U	5.2	5.2	5.2

3a-3n: 100 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 4a-4n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.022	0.027	0.127	0.129	0.129	-0.038
Δφ U	4.8	5.5	5.6	5.6	5.6	2.5

3a-3n: 25 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 4a-4n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.172	0.172	0.275	0.276	0.277	0.111
Δφ U	4.4	5.2	5.3	5.3	5.3	2.1

4a-4n: 100 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.007	0.008	0.107	0.108	0.109	-0.060
Δφ U	5.6	6.4	6.4	6.4	6.5	3.3

4a-4n: 25 VA p.f. = 0,8 lag.
1a-1n: 100VA; 2a-2n: 100VA; 3a-3n: 100VA p.f. = 0,8 lag.

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	-0.088	-0.096	0.001	0.002	0.002	-0.165
Δφ U	-1.9	-1.0	-0.6	-0.6	-0.6	-4.1

4a-4n: 25 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.179	0.176	0.273	0.274	0.275	0.107
Δφ U	4.8	5.4	5.5	5.5	5.5	2.3

da-dn: 200 VA p.f. = 0,8 lag.
1a-1n: 100VA; 2a-2n: 100VA; 3a-3n: 100VA; 4a-4n: 100VA p.f. = 0,8 lag.

	0,8 Un	1,0 Un	1,2 Un
ε U	-0.177	-0.159	-0.125
Δφ U	16.6	16.1	15.3

da-dn: 60 VA p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	1.053	1.053	1.053
Δφ U	9.7	9.7	9.8

* at 1,9 Un winding da-dn is loaded with 200 VA, p.f. = 0,8

Determination of current part errors (ε 1%), Δφ (min)

Ipn (A): 150

1S1-1S2: 30 VA p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.165	-0.113	-0.044	-0.060
Δφ I	4.3	1.7	-0.4	0.9

1S1-1S2: 7.50 VA p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.020	-0.017	0.003	0.007
Δφ I	2.4	1.6	0.4	0.2

2S1-2S2: 40 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.141
Δφ I	0.9

3S1-3S2: 60 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.153
Δφ I	1.7

4S1-4S2: 60 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.146
Δφ I	1.3

Ipn (A): 300

1S1-1S2: 30 VA p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.441	-0.110	-0.042	-0.057
Δφ I	17.7	1.6	-0.4	0.7

1S1-1S2: 7.50 VA p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.043	-0.018	0.003	0.004
Δφ I	3.1	2.1	0.5	0.6

2S1-2S2: 40 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.140
Δφ I	0.8

3S1-3S2: 60 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.148
Δφ I	1.7

4S1-4S2: 60 VA p.f. = 0,8 lag.

	1,0 In
ε I	-0.145
Δφ I	1.2

Current part: Measurements $\varepsilon_I = \pm 0{,}046\ \%$, $\Delta\varphi_I = \pm 2{,}3$ min
Voltage part: Measurements uncertainty: $\varepsilon_U = \pm 0{,}044\ \%$, $\Delta\varphi_U = \pm 2{,}2$ min

Determination of the over current factors:

- Instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	EFS [V]	Condition	Assessment
1S1-1S2	2.6	17.84	36.02	U < EFS	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Winding	EALF [V]	Ie [A]	ε_c [%]	Condition	Assessment
2S1-2S2	960.93	0.015	0.08	$\varepsilon_c \leq 5\%$	☑

3S2	278.86	0.097	0.1	$\varepsilon_a \leq 5\%$	☑
4S2	1388.83	0.015	0.08	$\varepsilon_a \leq 5\%$	☑

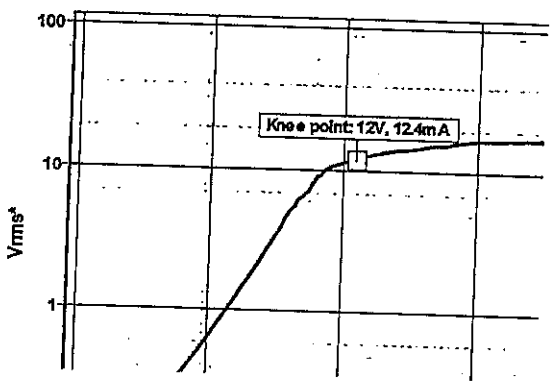
ent of capacitance and dielectric dissipation factor - δ
e: 24.2 °C, Frequency: 50

Instrument transformer			Current part			Voltage part		
Tg δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current
[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
0.23	1404	4.399	0.24	1128	3.572	0.23	275	0.862
0.23	1404	27.83	0.24	1129	22.34	0.22	276	5.46
0.23	1404	31.36	0.24	1129	25.21	0.22	276	6.156

tization characteristics:

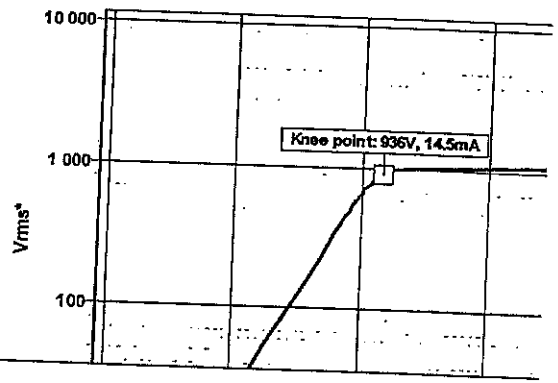
1-1S2

[mA]
3659
103.41
48.71
27.86
19.59
15.84
12.69
10.63
9.23
7.96
5.89
4.59
3.37
1.96
0.25



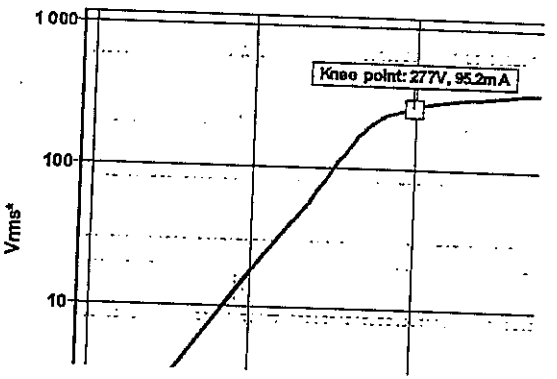
Winding 2S1-2S2

[V]	[mA]
1132.4	1427.9
1127.1	877.7
1104.4	263.7
1029.5	26.54
1000.1	17.54
978.	16.07
948.	14.66
894.	13.85
832	12.48
782.	11.95
612	9.3
442.	7.32
274.	5.42
103.	2.88
10.2	0.66



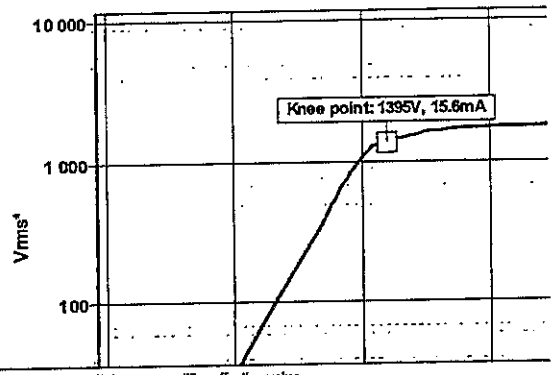
Winding 3S1-3S2

[V]	[mA]
375.	7431
331.	241.8
310.	162
304.	146.6
297.	128
282.	101.48
266.	83.09
253.	72.52
239.	65.23
197.	51.48
153.	41.82
111	33.85
68.6	25.06
26.5	13.39
2.4	2.72



s2

[mA]
2020.9
80.36
35.01
23.91
21.62
17.85
15.51
13.82
12.48
9.76
8.05
6.47
4.93
2.82
0.52



*) Average rectifier effective value.

of windings' resistance

tance of current part:

	R (23 °C)	Rct (75 °C)
e 150A	1883.0 µΩ	2267.8 µΩ
e 300A	970.0 µΩ	1168.2 µΩ
S2	0.239 Ω	0.287 Ω
S2	7.990 Ω	9.623 Ω
S2	0.389 Ω	0.468 Ω
S2	9.450 Ω	11.381 Ω

tance of voltage part:

	R (23 °C)	Rct (75 °C)
	21.30 kΩ	25.653 kΩ
	47.010 mΩ	56.617 mΩ
	48.480 mΩ	58.387 mΩ
	50.000 mΩ	60.218 mΩ
	51.700 mΩ	62.265 mΩ
	34.080 mΩ	41.045 mΩ

Przasnysz, 2013-12-04

ABB Sp. z o.o. 06-300 Przasnysz ul. Leszno 59	Routine tests report of combined instrument transformer After short time current test			TYPE: PVA145a Serial no: 2GKP013K1486145	
A-N	Insulation level:	Voltage factor:	Ith 1s [kA]:	Idyn [kA]:	Ioth [A]:	IEC 61869-4
132:√3 kV	145/275/650 kV	1.9/8h	20-20	50-50	225-450	50 Hz

	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
VOLTAGE PART	1a - 1n	0,11:√3	100	1,0	1000
	2a - 2n	0,11:√3	100	1,0	1000
	3a - 3n	0,11:√3	100	1/3P	1000
	4a - 4n	0,11:√3	100	3/3P	1000
	da - dn	0,11:3	200	3,0	450

	Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
CURRENT PART	1S1-1S2	5	30	0,2FS 5	150-300/5
	2S1-2S2	1	40	5P 20	150-300/1
	3S1-3S2	5	60	5P 20	150-300/5
	4S1-4S2	1	60	5P 20	150-300/1

List of performed tests:

1. Oil dielectric parameters check before filling (oil after treatment): ☑
   tg δ acc. IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil
4. Power-frequency withstand on primary windings - P1+P2/A: Up = 247,5 kV / 60s, f = 97Hz; N: Up = 3kV / 60s, f = 50Hz ☑
5. Partial discharge ☑
6. Power-frequency withstand test on secondary - Up = 3 kV/60s ☑
7. Inter-turn overvoltage test for current - lower value (U peak=4,5KV or U peak for Ioth) / ☑
8. Determination of errors ☑
9. Determination of the over current factors: FS, ALF ☑
10. Measurement of capacitance and dielectric dissipation factor - tg δ transformer ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

Oil dielectric parameters check before filling (oil after

- Measurement of oil tg δ according to IEC
  Tg δ = 0.06 %; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage = 78.15 kV, Relative standard deviation = 5.99
  f = 50Hz, oil temp. = 25 °C, measurement with the stirrer, type of electrodes used: partially

Sample	Breakdown voltage [kV]
1	73.7
2	84.3
3	82.8
4	78.4
5	76.9
6	72.8

charge measurement

ment according to procedure B

oltage: 247,5 kV / 60
ncy: 97 Hz

Test voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100,5 kV
evel of partial discharge	2.5 pC	1.2 pC

background noise level: 1 (measured after voltage switch off).
g circuit was calibrated with 5 pC (calibrating

vervoltage test for current transformers

ng	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
2	0.384	450
2	4.5	430
2	1.07	450
2	4.5	280

tion of voltage part errors (ε U%). Δφ U min)

VA
3a-3n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

Un	1,0 Un	1,2 Un
63	-0.163	-0.162
3	-1.3	-1.3

3a-3n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

Un	1,0 Un	1,2 Un
17	-0.016	-0.016
3	-1.3	-1.3

a-3n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

n	1,0 Un	1,2 Un
2	-0.161	-0.161
1	-1.1	-1.1

a-3n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

n	1,0 Un	1,2 Un
8	-0.015	-0.015
3	-1.3	-1.3

a-2n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
-0.254	-0.151	-0.149	-0.149	-0.314
-1.2	-0.8	-0.8	-0.8	-4.2

a-2n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
-0.103	-0.004	-0.003	-0.003	-0.170
-1.5	-1.1	-1.1	-1.1	-4.6

2n: 100VA; 3a-3n: 100VA — p.f. = 0,8 lag.

0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
-0.265	-0.165	-0.164	-0.164	-0.329
0.0	0.4	0.4	0.4	-3.1

1a-1n: 100 VA — p.f. = 0,8 lag.
2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.115	0.117	0.118
Δφ U	5.1	5.1	5.2

1a-1n: 25 VA — p.f. = 0,8 lag.
2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.263	0.265	0.265
Δφ U	5.1	5.1	5.2

2a-2n: 100 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.117	0.119	0.119
Δφ U	5.3	5.4	5.4

2a-2n: 25 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	0.265	0.267	0.267
Δφ U	5.2	5.2	5.2

3a-3n: 100 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 4a-4n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.023	0.024	0.127	0.129	0.129	-0.038
Δφ U	4.7	5.5	5.5	5.6	5.6	2.5

3a-3n: 25 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 4a-4n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.174	0.175	0.274	0.276	0.277	0.111
Δφ U	4.4	5.2	5.3	5.2	5.3	2.1

4a-4n: 100 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.007	0.006	0.106	0.107	0.107	-0.060
Δφ U	5.7	6.5	6.5	6.5	6.5	3.3

4a-4n: 25 VA — p.f. = 0,8 lag.
1a-1n: 100VA; 2a-2n: 100VA; 3a-3n: 100VA — p.f. = 0,8 lag.

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	-0.095	-0.096	0.001	0.003	0.002	-0.165
Δφ U	-1.8	-0.9	-0.6	-0.6	-0.6	-4.1

da-dn: 200 VA — p.f. = 0,8 lag.
1a-1n: 100VA; 2a-2n: 100VA; 3a-3n: 100VA; 4a-4n: 100VA — p.f. = 0,8 lag.

	0,8 Un	1,0 Un	1,2 Un
ε U	-0.177	-0.159	-0.125
Δφ U	16.8	16.1	15.3

4a-4n: 25 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA

	0,02 Un	0,05 Un	0,8 Un	1,0 Un	1,2 Un	1,9 Un*
ε U	0.174	0.174	0.273	0.274	0.275	0.107
Δφ U	4.7	5.5	5.5	5.5	5.5	2.3

da-dn: 50 VA — p.f. = 0,8 lag.
1a-1n: 0 VA; 2a-2n: 0 VA; 3a-3n: 0 VA; 4a-4n: 0 VA

	0,8 Un	1,0 Un	1,2 Un
ε U	1.000	1.001	0.995
Δφ U	11.1	11.1	11.2

* at 1,9 Un winding da-dn is loaded with 200 VA, p.f. = 0,8

Determination of current part errors (ε I%). Δφ I min)

Ipn (A): 150

1S1-1S2: 30 VA — p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.175	-0.105	-0.042	-0.050
Δφ I	4.8	1.5	-0.4	0.5

1S1-1S2: 7.50 VA — p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.023	-0.014	0.002	0.007
Δφ I	2.8	1.5	0.5	0.4

2S1-2S2: 40 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.139
Δφ I	0.9

3S1-3S2: 60 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.160
Δφ I	1.2

4S1-4S2: 60 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.149
Δφ I	1.0

Ipn (A): 300

1S1-1S2: 30 VA — p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.158	-0.101	-0.041	-0.056
Δφ I	4.7	1.4	-0.4	0.7

1S1-1S2: 7.50 VA — p.f. = 0,8 lag.

	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.014	-0.008	0.004	0.007
Δφ I	2.5	1.4	0.5	0.5

2S1-2S2: 40 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.139
Δφ I	0.8

3S1-3S2: 60 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.157
Δφ I	1.3

4S1-4S2: 60 VA — p.f. = 0,8 lag.

	1,0 In
ε I	-0.144
Δφ I	1.0

Current part: Measurements — ε_I = ± 0,045 %, $\Delta\varphi_I$ = ± 2,3 min
Voltage part: Measurements uncertainty: ε_U = ± 0,044 %, $\Delta\varphi_U$ = ± 2,2 min

Determination of the over current factors:

- Instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	EFS [V]	Condition	Assessment
1S1-1S2	2.5	17.84	35.93	U < EFS	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Winding	EALF [V]	Ie [A]	εc [%]	Condition	Assessment
2S1-2S2	960.1	0.015	0.08	εc ≤ 5%	☑

	278.51	0.1	0.1	εe ≤5%	☑
	1385.12	0.015	0.08	εe ≤5%	☑

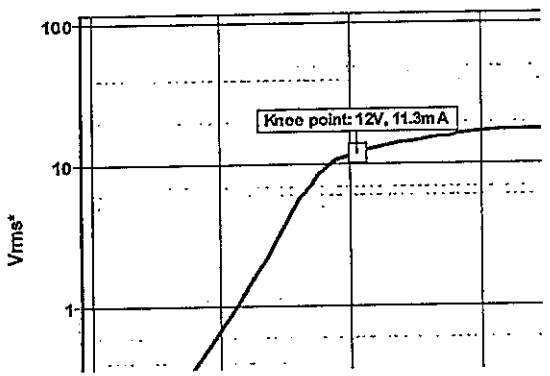
f capacitance and dielectric dissipation factor - δ
2 °C, Frequency: 50

Instrument transformer			Current part			Voltage part		
g δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current
[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
0.23	1391	4.392	0.24	1115	3.53	0.23	275	0.871
0.23	1391	27.54	0.23	1115	22.08	0.23	275	5.453
0.23	1391	30.91	0.23	1115	24.79	0.23	275	6.122

tion characteristics:

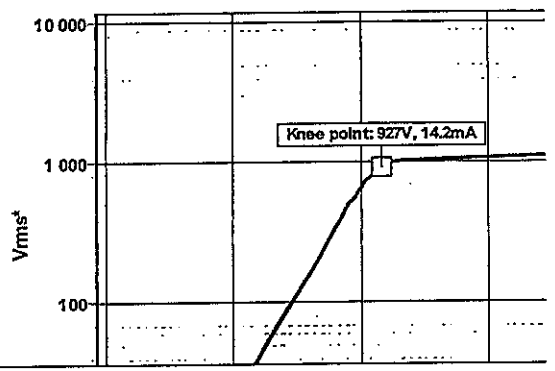
S2

[mA]
3519.8
136.6
57.25
31.73
17.13
13.6
11.35
9.58
8.2
7.37
5.62
4.34
3.25
1.86
0.24



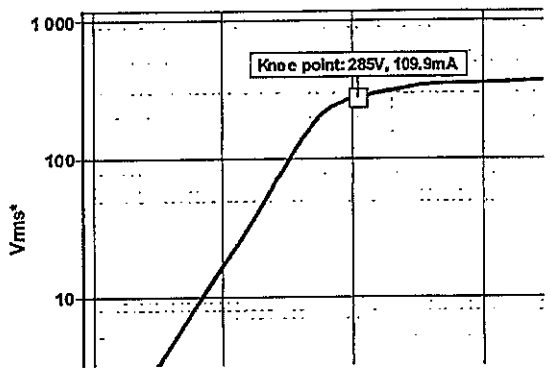
Winding 2S1-2S2

[V]	[mA]
1134.6	1823
1130.8	1194.6
1113.7	432.2
1047	40.79
1019.9	21.84
990.	16.73
967.	15.44
901.	13.44
847.	12.71
794.	12.29
621.	9.61
449.	7.46
277.	5.5
105.	2.95
10.7	0.7



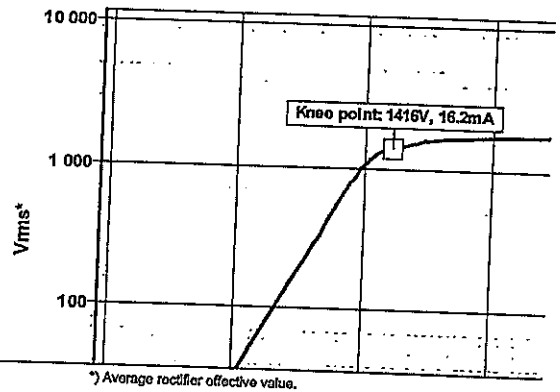
Winding 3S1-3S2

[V]	[mA]
377.	10440
335.	258.5
314	170.6
305.	148.6
300.	136.7
283.	106.74
270.	89.86
257	77.84
242.	68.66
200.	53.43
156.	43.17
113.	34.76
70.1	25.63
26.4	13.48
2.6	2.82



31-432

	[mA]
	1774.6
	76.4
	31.58
	22.36
	20.66
	18.86
	16.1
	14.04
	12.73
	9.9
	8.23
	6.51
	4.9
	2.81
	0.53



*) Average rectifier effective value.

of windings' resistance

stance of current part:

	R (23 °C)	Rct (75 °C)
e 150A	1708.0 µΩ	2054.6 µΩ
e 300A	881.0 µΩ	1061.0 µΩ
S2	0.236 Ω	0.284 Ω
S2	7.950 Ω	9.575 Ω
S2	0.385 Ω	0.464 Ω
S2	9.270 Ω	11.164 Ω

ance of voltage part:

	R (23 °C)	Rct (75 °C)
	20.90 kΩ	25.171 kΩ
	46.820 mΩ	56.388 mΩ
	48.340 mΩ	58.219 mΩ
	49.840 mΩ	60.025 mΩ
	51.400 mΩ	61.904 mΩ
	34.010 mΩ	40.960 mΩ

Przasnysz, 2014-01-03

ANNEX 4 **Documentations delivered by orderer**

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 092/2013 (EN)
(acc. to ISO/IEC 17050-1)

Manufacturer: ABB Sp. z o.o. Dept. in Przasnysz

Address: Str. Leszno 59
06-300 Przasnysz / POLAND

Product: Combined Instrument Transformer PVA 145a

Above mentioned product comforms with the following standard :

Standard	Title	Edition/Date
IEC 61869 - 4	Combined Instrument Transformers	2013

Additional information:
Serial numbers: **2GKP013K1486145;**

Place and date of issue of declaration

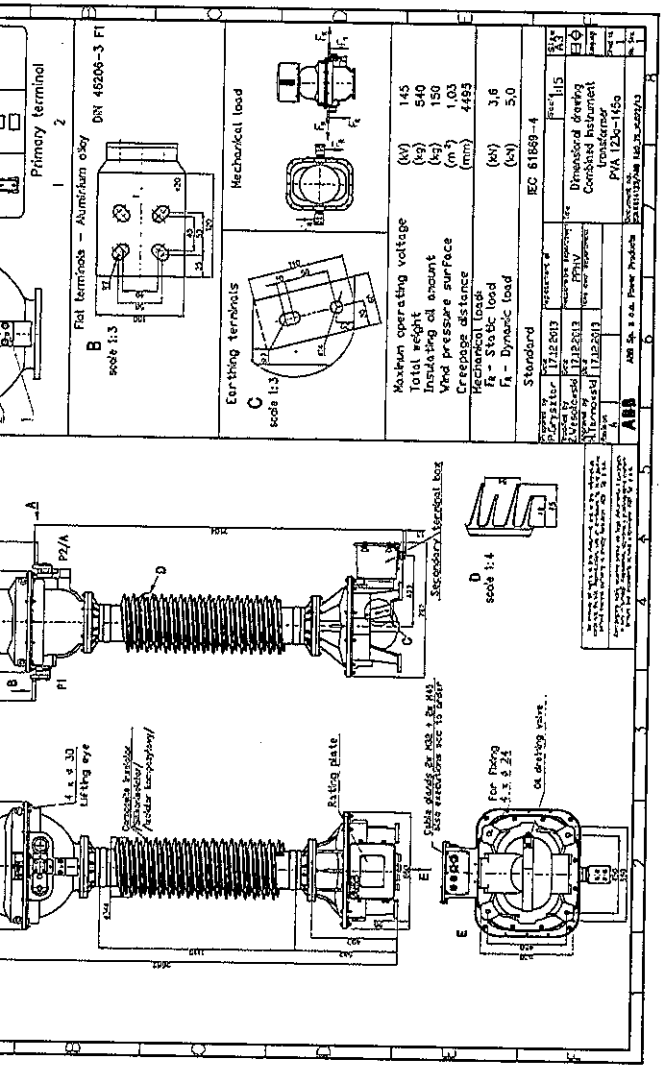
Przasnysz 13.01.2014

ABB
ABB Sp. z o.o.
ul. Żegańska 1, 04-713 Warszawa
NIP: 526-030-44-64; PL 5260304464
Regon 010017166
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
tel. (22) 223 8021, fax (22) 223 8058
(0)

Kierownik ds. Realizacji Zam...
ABB Sp. z o.o.
Oddział w Przasnyszu
Małgorzata Niedziewska

Kierownik ds. Zapewnienia ...
ABB Sp. z o.o.
Oddział w Przasnyszu
Krzysztof Łabecki

(Name) (Signature)



ABB

Combined Instrument Transformer

Type	PVA 145a				
Insulation level	145/275/650 kV	Standard	IEC 61869-4	fn	50 Hz
Oil type	Nytro Libra	Weight / Oil weight	540 / 150 kg	Temp. range	-50°C — +40°C
S/N	2GKP013K1486145	Voltage factor	1,9Un/8h	Ue	0,2 mV/kA

CURRENT PART

K_n 150-300 / 5-1-5-1 A/A

$I_{th}/1s$ 20-20 kA I_{dyn} 50-50 kA

I_{cth} 180-360 A

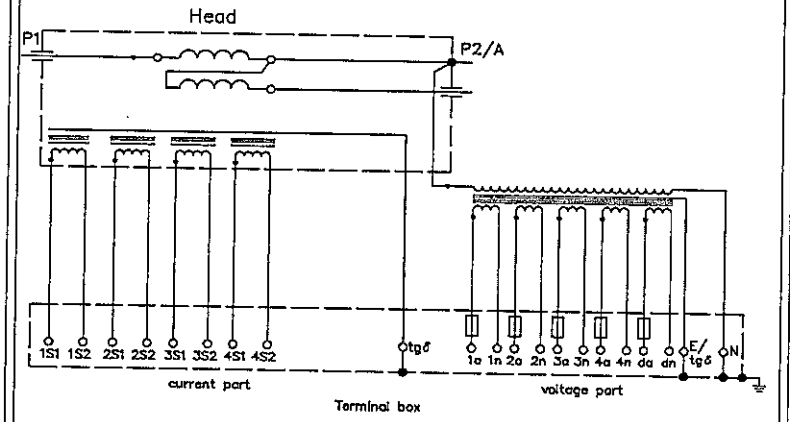
	1S1-1S2	2S1-2S2	3S1-3S2	4S1-4S2	5S1-5S2	6S1-6S2
A	5	1	5	1		
VA	30	40	60	60		
Kl.	0,2	5P	5P	5P		
FS/ALF	5	20	20	20		
Ext.%	120					

VOLTAGE PART

A-N 132:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	110:√3	110:√3	110:√3	110:√3	110:3
VA	100	100	100	100	200
Kl.	1,0	1,0	1/3P	3/3P	3,0
VA_{sm}	1000	1000	1000	1000	450

Transportation Vertical / Horizontal



Instrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 – XS2
2. DURING INSTRUMENT TRANSFORMER OPERATION TERMINALS: N, E/tgδ, tgδ MUST BE EARTHED
3. AFTER THREE WINDINGS da – dn ARE CONNECTED IN BROKEN DELTA THE CIRCUIT CLOSED

INSTITUTE OF POWER ENGINEERING
DISTRIBUTION EQUIPMENT LABORATORY

01-330 Warsaw, ul Mory 8
tel.fax. +48 22 836-73-35
tel. +48 22 345-13-86

TEST REPORT No. EUR/23/E/14 E

Combined instrument transformer type PVA 145a with composite insulator
Serial No. 2GKP013K1486144/13

ER: ABB Sp. z o.o. Division in Przasnysz, ul. Leszno 59, 06-300 Przasnysz

ED BY: ABB Sp. z o.o., ul. Żegańska 1, 04-713 Warszawa
Order No. 4500554112 z dnia 25.04.2014

S: Short-time current tests
Test for composite error

DURE: According to IEC 61869-2:2012

'S: 12/13.05.2014

T: Positive for
I_{dyn} = 100 kA, I_{th} = 40 kA, t = 1 s for 300 A terminal

Tests result refers only to the test object

ERE
Y: Z. Wesołowski – ABB Sp. z o.o.

gineer

zmarczyk

HEAD OF LABORATORY

Lidia Gruza

Contents **Page**

Report contents:

numbered pages	23
records (pages not numbered)	3
tables	2
figures	2
photographs	1

JECT

cription

ed instrument transformer type PVA 145a is used for supplying of measuring and its in the network of maximum operating voltage 145 kV and frequency 50 Hz. The sists of current and voltage transformers mounted in common housing with ator immersed with transformer oil.

ed instrument transformer delivered for the tests wasn't equipped with voltage current transformer wasn't equipped with 2S1-2S2 winding.

nical data

ufacturer attributed the following construction data to the test object.

ting voltage	145 kV
	50 Hz
s thermal current	360 A, 720 A
current for 1 s	40 kA
urrent	100 kA

nical documentation

e of tests the orderer delivered the following technical documentation:
ort of combined instrument transformer before short-time current test (29.04.2014)
ort of combined instrument transformer after short-time current test (16.05.2014),
wing combined transformer PVA 123a-145a, No. 2GKK614123 (17.12.2013),

former electrical diagram
Sp. z o.o (Annex 3 and 4).
oceeded the identification of test object on the base of above documentation and onformity of manufacturing with constructional documentation is stated declaration, copy of which presents Annex 4.

ration for tests

was prepared for tests in the factory by the manufacturer.

TESTS

greed with orderer, comprised the following tests according to requirements of :

ent tests of current transformer acc. to item 7.2.201 of above standard at

kA, I_{th} = 40 kA, t_{th} = 1 s, $I_{th}^2 \times t_{th} \geq 1600$ kA^2×s for 300 A terminal.

e error acc. to item 7.2.6.203 of above standard with current's transformer burden 5%) connected to 3S1-3S2 windings at parameters:
kA, t_{th} = 1 s for 300 A terminal,

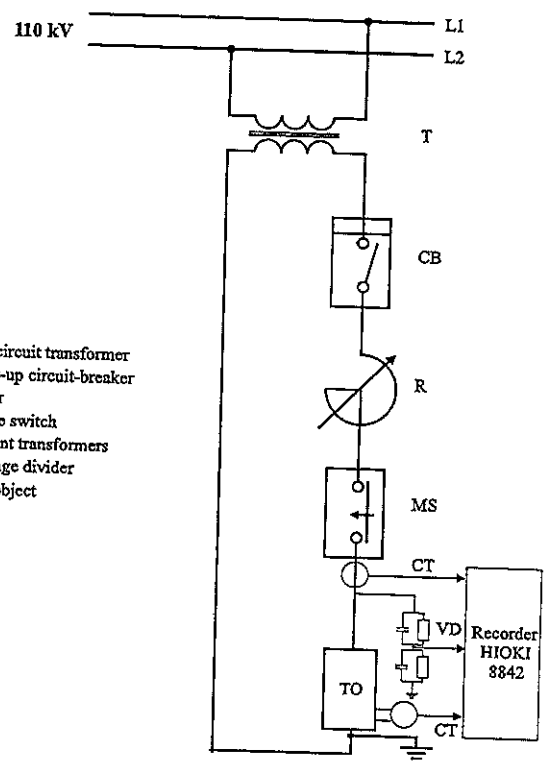
e and after short-time current test made in factory.

3. TEST AND MEASURING CIRCUITS

For the tests the transformer was fixed to the rigid construction of the test stand. Short-time current tests and test for composite error were made in single-phase circuit presented on fig. 1 at dimensions presented on fig.2.
The following quantities were recorded during the tests using digital recorder type HIOKI 8842:

- primary current (with short-circuited all secondary terminals) using laboratory current transformer type CdC class 0,5 with a ratio 50.000/2 A/A (uncertainty of measurement ±0,018% for k = 2),
- secondary currents in 1S1-1S2, 3S1-3S2, 4S1-4S2 windings by means of laboratory toroidal current transformers type IL20a class 0,5 with a ratio 500/5 A/A, 1.000/5 A/A and 2.000/5 A/A (uncertainty of measurement ±0,012% for k = 2),
- voltage drop (U_0) on test object during short-time current tests by means of a resistance-capacitance voltage divider with a bandwidth from 0 to 100 kHz.

T - short-circuit transformer
CB - back-up circuit-breaker
R - reactor
MS - make switch
CT - current transformers
VD - voltage divider
TO - test object



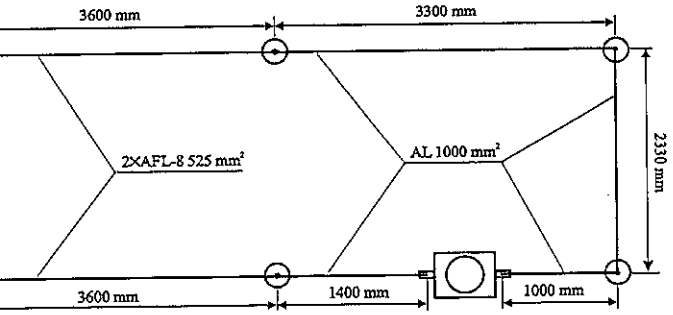


Fig. 2. Configuration of test circuit during tests

D THEIRS DETAILED RESULTS

lts presents tables 1 and 2. During the tests the following records were made:
Nos. 33757, 33758, 33762 – calibration of measuring and test circuit,
No. 33759 – composite error test,
Nos. 33763, 33764 – short-time current tests,
(Annex 1 presents the copies of short-circuit test records - all records are stored in laboratory's archives),
hot. 1 – current transformer on short-circuit tests stand
(Annex 2 presents the photograph).

osite error test current's transformer burden connected to 3S1-3S2 was

of composite error test for 3S1-3S2 winding

I_p	ε_c	t_z	Observations
kA	%	s	-
5,32	4,04	0,99	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

r.m.s. value of the test current (determined from test period without asymmetrical component),
test duration,

$$\frac{\sqrt{\frac{1}{T}\int_0^T (k_r \cdot i_s - i_p)^2 dt}}{I_p} \cdot 100\%$$

rated transformation ratio (300/5 A/A),
instantaneous value of the primary current,
instantaneous value of the secondary current,

Table 2. Results of short-time current tests

Test No.	i_{peak}	I_t	t_t	$I_t^2 \times t_t$	$I_{1S1-1S2}$	$I_{3S1-3S2}$	$I_{4S1-4S2}$	U_0	Observations
-	kA	kA	s	$(kA)^2 \times s$	A	A	A	V	-
33763	100,24[1)]	40,12	0,08	–	–	–	–	–	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.
33764	71,71	40,12	1,00	1610[2)]	239*	611	126	176	Behaviour of transformer during the test was correct. After test no damage nor oil leak was stated.

Legend:
i_{peak} – peak value of test current,
I_t – r.m.s. value of test current (determined from test period without asymmetrical component),
t_t – test duration,
$I_{1S1-1S2}$ – r.m.s. value (determined from test period without asymmetrical component),
$I_{3S1-3S2}$ – r.m.s. value (determined from test period without asymmetrical component),
$I_{4S1-4S2}$ – r.m.s. value (determined from test period without asymmetrical component),
U_0 – r.m.s. value of voltage drop (determined from test period without asymmetrical component).
Required : 1) $i_{peak} \geq 100$ kA,
2) $I_t^2 \times t_t \geq 1600$ $(kA)^2 \times s$,
* – deformed waveform.

5. TESTS RESULTS EVALUATION

According to criteria given in IEC 61869-2:2012 the results of tests is positive for:

$I_{dyn} = 100$ kA, $I_{th} = 40$ kA, $t = 1$ s for 300 A terminal of tested combined instrument transformer.

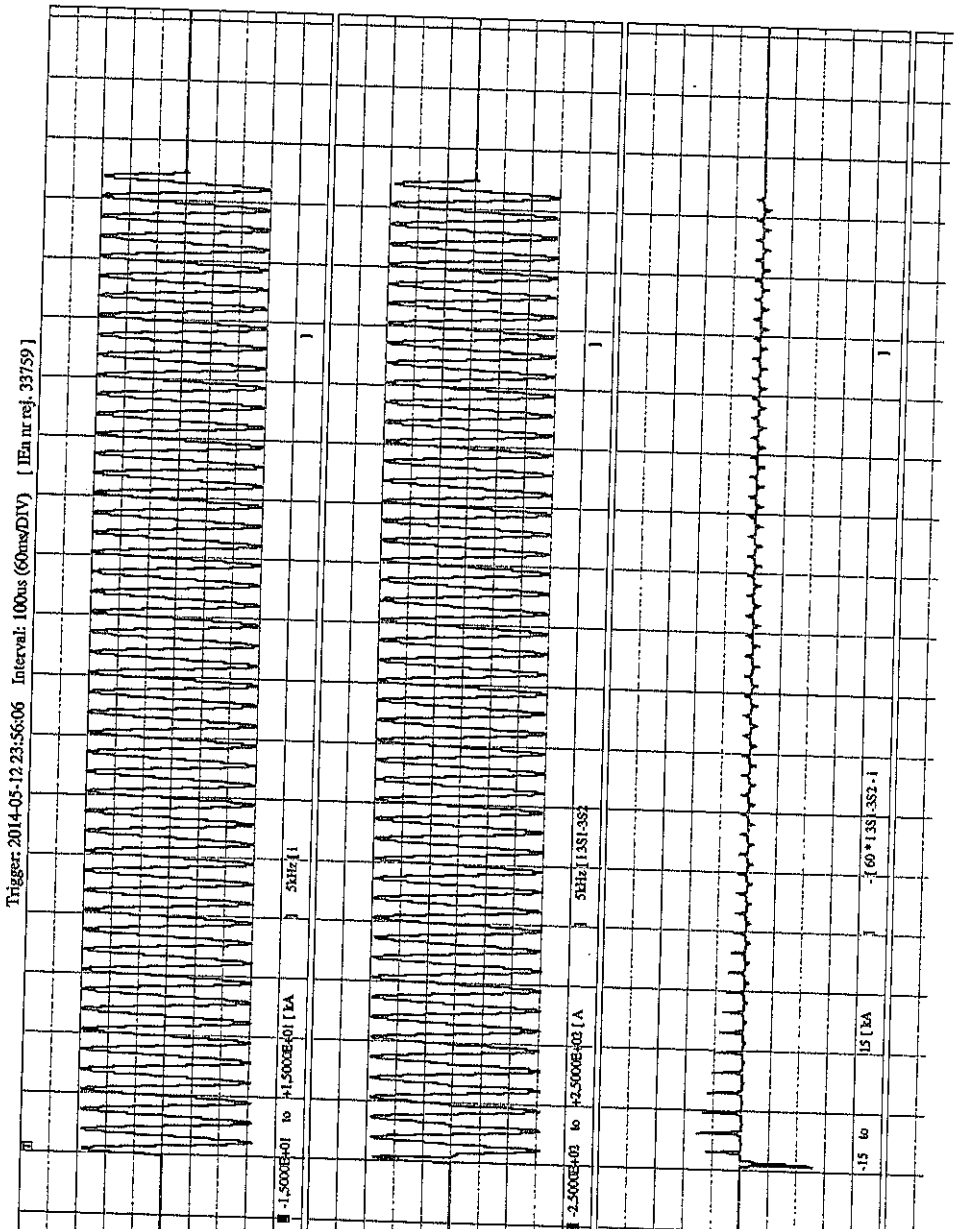
Test records

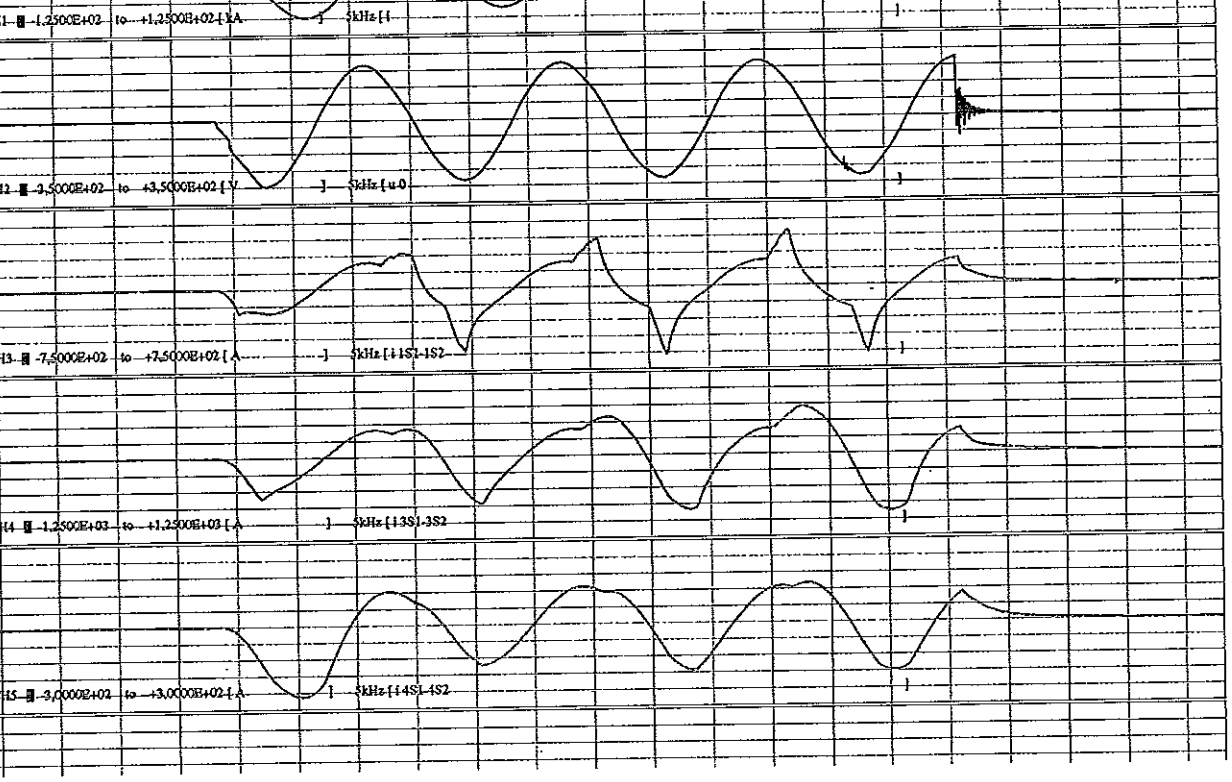
As not numbered pages the following copies of records are given:

33759 – composite error test,
33763, 33764 – short-time current tests.

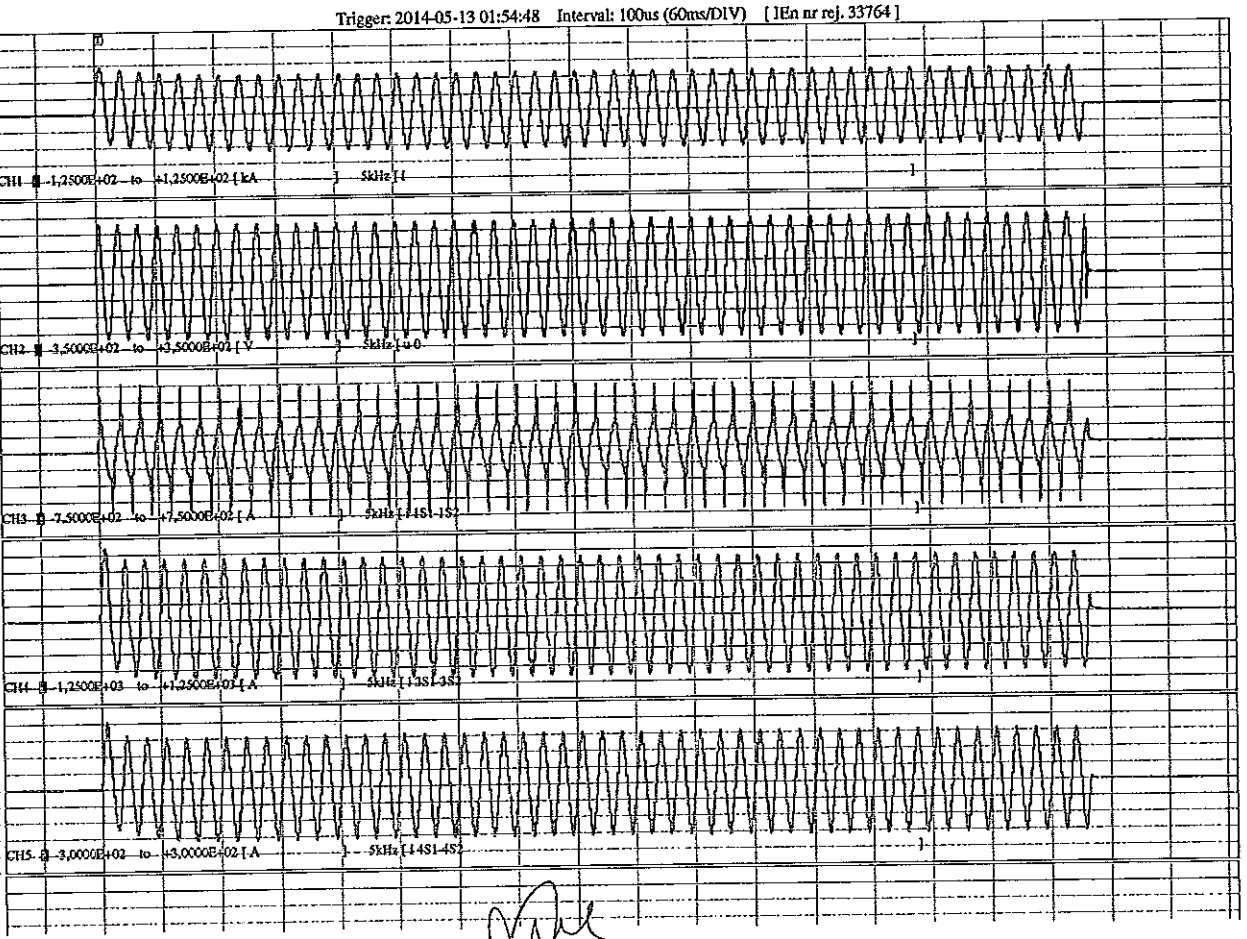
ons:

o on test object,
2 winding current,
2 winding current,
2 winding current,
– secondary current in 3S1-3S2 winding (including ratio) minus primary current.

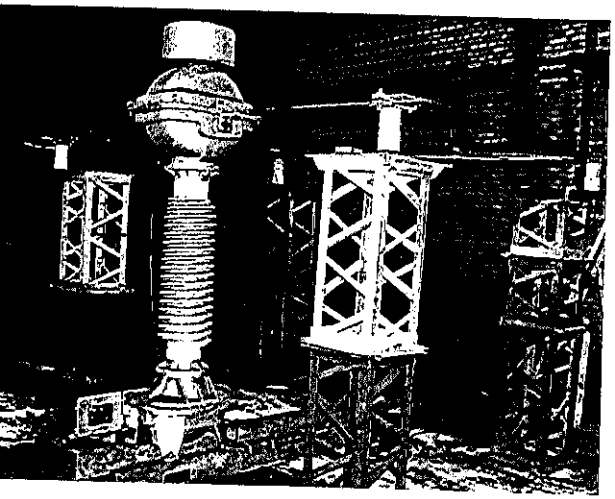




Trigger: 2014-05-13 01:54:48 Interval: 100us (60ms/DIV) [IEn nr rej. 33764]



Photographs taken during the tests



Phot. 1. PVA 145a after short-time current tests

ANNEX 3 Routine test report before and after short-time current tests

ABB Sp. z o.o. 06-300 Przasnysz ul. Leszno 59		Routine tests report of combined instrument transformer before short time current test			TYPE: PVA145a Serial no: 2GKP013K1486144	
A-N	Insulation level:	Voltage factor:	Ith 1s [kA]:	Idyn [kA]:	Icth [A]:	IEC 61869-4
132:√3 kV	145/275/650 kV	1.9/8h	40-40	100-100	450-900	50 Hz

VOLTAGE PART *)	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a - 1n	0,11:√3	0->10	0,1	1000
	2a - 2n	0,11:√3	25	0,1	1000
	3a - 3n	0,11:√3	25	0,1/3P	1000
	4a - 4n	0,11:√3	40	1/3P	1000
	da - dn	0,11	100	1,0	450

CURRENT PART	Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
	1S1-1S2	5	40	0,2FS 5	300-600/5
	2S1-2S2	1	30	0,5FS 10	300-600/1 **)
	3S1-3S2	5	60	5P 20	300-600/5
	4S1-4S2	1	120	10P 15	300-600/1

List of performed tests:

1. Oil dielectric strictures check before filling (oil after treatment): tg δ acc. IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal markings ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil leakage ☑
4. Power-frequency withstand test on primary windings - P1+P2/A: Up = 247,5 kV / 60s, f = 97Hz N: Up = 3kV / 60s, f = 50Hz ☑
5. Partial discharge measurement ☑
6. Power-frequency withstand test on secondary windings - Up = 3 kV/60s ☑
7. Inter-turn overvoltage test for current transformers - lower value (U peak=4,5kV or U peak for Icth) / 60s ☑
8. Determination of errors ☑
9. Determination of the over current factors: FS, ALF ☑
10. Measurement of capacitance and dielectric dissipation factor - tgδ ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tg δ according to IEC 60247
  Tg δ = 0.08 %; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C ±1C.

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage = 73.62 kV, Relative standard deviation = 6,99 %;
  f = 50Hz, oil temp. = 28 °C, measurement with the stirrer, type of electrodes used: partially spherical.

Sample	Breakdown voltage [kV]
1	71.3
2	73.8
3	68.9
4	83.6
5	71.7
6	72.4

*) In the combined instrument transformer lack of the voltage part
**) In the current part lack of the core 2S1-2S2

measurement

ccording to procedure A (PD test voltages were reached while decreasing the voltage after the ithstand test on primary winding)

: 275 kV / 60 s

Hz

st voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100,5 kV
partial discharge	5 pC	5 pC

round noise level: 2.5 (measured after voltage switch off).
It was calibrated with 5 pC (calibrating charge).

ltage test for current transformers

	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
	1.27	900
	1.92	900
	4.5	100

e combined instrument transformer lack of the voltage

Attention: IN the combined instrument transformer lack of the voltage part

Determination of current part errors (ε I%), Δφ I min)

Ipn (A): 300

1S1-1S2: 40 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.066	-0.049	-0.032	-0.029
Δφ I	1.1	0.2	-0.3	-0.3

2S1-2S2: 30 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.085	-0.060	-0.017	-0.027
Δφ I	2.9	1.2	-0.4	0.5

3S1-3S2: 60 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.127	
Δφ I	0.6	

1S1-1S2: 10 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.017	-0.016	-0.016	-0.015
Δφ I	0.4	0.2	0.1	0.1

2S1-2S2: 7.50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	0.009	0.011	0.014	0.016
Δφ I	1.3	0.8	0.3	0.2

4S1-4S2: 120 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.171	
Δφ I	1.0	

Ipn (A): 600

1S1-1S2: 40 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.058	-0.050	-0.032	-0.029
Δφ I	1.0	0.4	-0.2	-0.1

2S1-2S2: 30 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.077	-0.060	-0.018	-0.039
Δφ I	2.7	1.3	-0.3	1.1

3S1-3S2: 60 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.124	
Δφ I	0.6	

1S1-1S2: 10 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.012	-0.015	-0.014	-0.013
Δφ I	0.1	0.1	0.0	-0.1

2S1-2S2: 7.50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	0.017	0.013	0.017	0.018
Δφ I	1.1	0.8	0.2	0.1

4S1-4S2: 120 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.167	
Δφ I	1.0	

Current part: Measurements uncertainty: $\varepsilon_I = \pm 0{,}045$ %, $\Delta\varphi_I = \pm 2{,}3$ min
Voltage part: Measurements uncertainty: $\varepsilon_U = \pm 0{,}044$ %, $\Delta\varphi_U = \pm 2{,}2$ min

Determination of the over current factors:

- Instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	Efs [V]	Condition	Assessment
1S1-1S2	2.5	31.14	50.12	U < Efs	☑
2S1-2S2	1	97.04	360.23	U < Efs	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Winding	Ealf [V]	Ie [A]	εc [%]	Condition	Assessment

S2	284.16	0.185	0.19	$\varepsilon_c \leq 5\%$	☑
S2	1940	0.022	0.15	$\varepsilon_a \leq 10\%$	☑

nt of capacitance and dielectric dissipation factor - tg δ

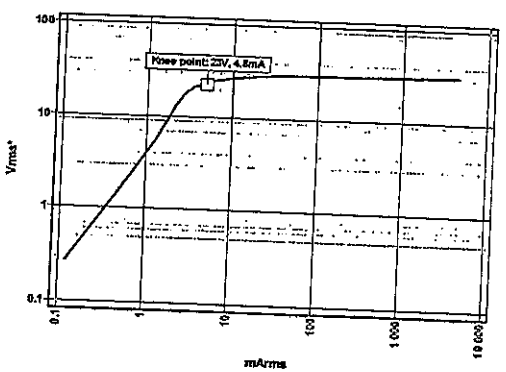
22.5 °C, Frequency: 50 Hz

Instrument transformer			Current part			Voltage part		
Tg δ [%]	Capacity [pF]	Leak.current [mA]	Tg δ [%]	Capacity [pF]	Leak.current [mA]	Tg δ [%]	Capacity [pF]	Leak.current [mA]
0.24	1387	4.405	0.25	1110	3.524	0.22	277	0.679
0.25	1387	27.48	0.25	1110	21.97	0.22	277	5.481
0.25	1387	31.05	0.25	1111	24.79	0.22	277	6.184

zation characteristics:

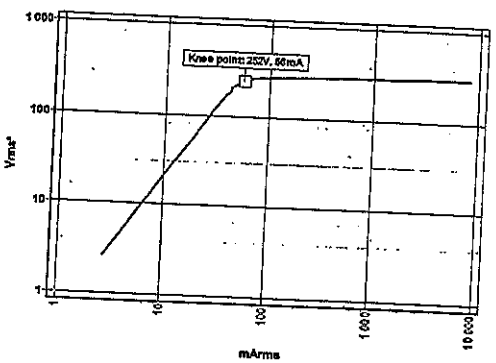
1S2

[mA]
4558.2
2318.3
41.64
26.64
11.05
7.38
6.01
5.09
4.35
3.47
2.9
2.36
1.73
0.93
0.12



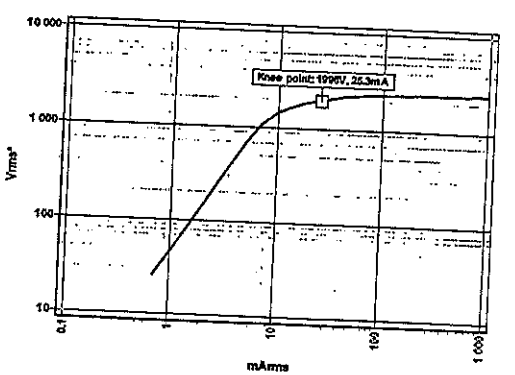
Winding 3S1-3S2

[V]	[mA]
308.5	8136
305.2	2960.3
302.2	1628.8
296.3	679.5
284.4	161.04
276.8	95.13
268.5	68.11
263.4	61.8
244.6	52.54
225.7	47.91
208.8	43.39
180	34.58
92.4	25.35
34.3	13.79
2.6	2.76



Winding 4S1-4S2

[V]	[mA]
2479.1	981.2
2472.2	758.1
2440.5	369.77
2368.9	127.27
2269.8	55.65
2195.4	43.02
2010.7	26.03
1823.9	17.24
1647.4	12.76
1463.9	10.05
1273	8.35
888.2	6.07
517.8	4.32
148.6	2.02
25.3	0.7



*) Average rectifier effective value.

Measurement of windings' resistance

Windings' resistance of current part:

	R (25 °C)	Rct (75 °C)
P1-P2 range 300A	617.0 μΩ	738.2 μΩ
P1-P2 range 600A	311.0 μΩ	372.1 μΩ
1S1-1S2	0.401 Ω	0.479 Ω
2S1-2S2	Ω	Ω
3S1-3S2	0.443 Ω	0.530 Ω
4S1-4S2	9.560 Ω	11.439 Ω

nce of voltage part:

	R (24 °C)	Rct (75 °C)
	kΩ	kΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ

OG-4
KJ-05

Przasnysz, 2014-04-29

ABB Sp. z o.o. 06-300 Przasnysz ul. Leszno 59	Routine tests report of combined instrument transformer After short time current test			TYPE: PVA145a Serial no: 2GKP013K1486144	
A-N	Insulation level:	Voltage factor:	Ith 1s [kA]:	Idyn [kA]:	Icth [A]:	IEC 61869-4
132:√3 kV	145/275/650 kV	1.9/8h	40-40	100-100	450-900	50 Hz

VOLTAGE PART *)	Winding	Usn [kV]	Sn [VA]	class	Sth [VA]
	1a - 1n	0,11:√3	0->10	0,1	1000
	2a - 2n	0,11:√3	25	0,1	1000
	3a - 3n	0,11:√3	25	0,1/3P	1000
	4a - 4n	0,11:√3	40	1/3P	1000
	da - dn	0,11	100	1,0	450

CURRENT PART	Winding	Isn [A]	Sn [VA]	class	Ratio [A/A]
	1S1-1S2	5	40	0,2FS 5	300-600/5 **)
	2S1-2S2	1	30	0,5FS 10	300-600/1
	3S1-3S2	5	60	5P 20	300-600/5
	4S1-4S2	1	120	10P 15	300-600/1

List of performed tests:

1. Oil dielectric strictures check before filling (oil after treatment): ☑
   tg δ acc. IEC 60247, breakdown voltage acc. IEC 60156 ☑
2. Verification of terminal markings ☑
3. Pressure and tightness test: oil overpressure: 0,8 bar / 24h – no traces of oil leakage
4. Power-frequency withstand test
   on primary windings - P1+P2/A: Up = 247,5 kV / 60s, f = 97Hz; N: Up = 3kV / 60s, f = 60Hz ☑
5. Partial discharge measurement ☑
6. Power-frequency withstand test on secondary windings - Up = 3 kV/60s ☑
7. Inter-turn overvoltage test for current transformers - lower value (U peak=4,5kV or U peak for Icth) / 60s ☑
8. Determination of errors ☑
9. Determination of the over current factors: FS, ALF ☑
10. Measurement of capacitance and dielectric dissipation factor – tgδ ☑
11. Determination of core magnetization characteristics ☑
12. Measurement of windings' resistance ☑

Oil dielectric parameters check before filling (oil after treatment)

- Measurement of oil tg δ according to IEC 60247
  Tg δ = 0.06 %; electrical stress = 1kV/mm, f = 50Hz, oil temp. = 90C ±1C.

- Measurement of breakdown voltage according to IEC 60156
  Mean breakdown voltage = 73.62 kV, Relative standard deviation = 6.99 %;
  f = 50Hz, oil temp. = 28 °C, measurement with the stirrer, type of electrodes used: partially spherical.

Sample	Breakdown voltage [kV]
1	71.3
2	73.8
3	68.9
4	83.6
5	71.7
6	72.4

*) In the combined instrument transformer lack of the voltage part
**) In the current part lack of the core 2S1-2S2

arge measurement

ent according to procedure B

age: 247,5 kV / 60 s
; 97 Hz

Test voltage	1,2 Um = 174 kV	1,2 Um / √3 = 100,5 kV
l of partial discharge	1.2 pC	1.2 pC

ackground noise level: 1.2 (measured after voltage switch off),
ircuit was calibrated with 5 pC (calibrating charge).

rvoltage test for current transformers

	Peak voltage on secondary winding [kVpeak]	Current in primary winding [A]
	1.31	900
	2	900
	4.5	100

the combined instrument transformer lack of the voltage

Attention: IN the combined instrument transformer lack of the voltage part

Determination of current part errors (ε I%), 4φ I min)

Ipn (A): 300

1S1-1S2: 40 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.061	-0.052	-0.033	-0.029
Δφ I	0.9	0.3	-0.2	-0.3

1S1-1S2: 10 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.015	-0.015	-0.014	-0.013
Δφ I	0.3	0.1	0.0	-0.0

2S1-2S2: 30 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.085	-0.060	-0.017	-0.027
Δφ I	2.9	1.2	-0.4	0.5

2S1-2S2: 7.50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	0.009	0.011	0.014	0.016
Δφ I	1.3	0.8	0.3	0.2

3S1-3S2: 60 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.125	
Δφ I	0.6	

4S1-4S2: 120 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.170	
Δφ I	1.0	

Ipn (A): 600

1S1-1S2: 40 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.063	-0.054	-0.034	-0.032
Δφ I	1.0	0.4	-0.2	-0.1

1S1-1S2: 10 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.013	-0.017	-0.015	-0.013
Δφ I	0.2	0.2	0.1	0.0

2S1-2S2: 30 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	-0.077	-0.060	-0.018	-0.039
Δφ I	2.7	1.3	-0.3	1.1

2S1-2S2: 7.50 VA				p.f. = 0,8 lag.
	0,05 In	0,2 In	1,0 In	1,5 In
ε I	0.017	0.013	0.017	0.018
Δφ I	1.1	0.8	0.2	0.1

3S1-3S2: 60 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.123	
Δφ I	0.6	

4S1-4S2: 120 VA		p.f. = 0,8 lag.
	1,0 In	
ε I	-0.168	
Δφ I	1.0	

Current part: Measurements uncertainty: $\varepsilon_I = \pm 0{,}045\ \%$, $\Delta\varphi_I = \pm 2{,}3$ min
Voltage part: Measurements uncertainty: $\varepsilon_U = \pm 0{,}044\ \%$, $\Delta\varphi_U = \pm 2{,}2$ min

Determination of the over current factors:

- Instrument security factor (FS) of measuring cores

Winding	Ie [A]	U [V]	EFS [V]	Condition	Assessment
1S1-1S2	2.5	31.39	49.66	U < EFS	☑
2S1-2S2	1	97.04	360.43	U < EFS	☑

- accuracy limit factor (ALF) – test for composite error ε_c of protective cores

Winding	EALF' [V]	Ie [A]	εc [%]	Condition	Assessment

	282.29	0.143	0.14	$\varepsilon_e \leq 5\%$	☑
	1934.49	0.022	0.15	$\varepsilon_e \leq 10\%$	☑

of capacitance and dielectric dissipation factor - tg δ

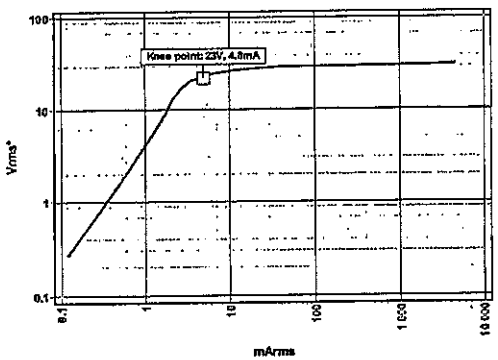
.5 °C, Frequency: 50 Hz

Instrument transformer			Current part			Voltage part		
Tg δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current	Tg δ	Capacity	Leak.current
[%]	[pF]	[mA]	[%]	[pF]	[mA]	[%]	[pF]	[mA]
0.24	1387	4.405	0.25	1110	3.524	0.22	277	0.879
0.26	1387	27.46	0.25	1110	21.97	0.22	277	5.481
0.25	1387	31.05	0.25	1111	24.79	0.22	277	6.184

ation characteristics:

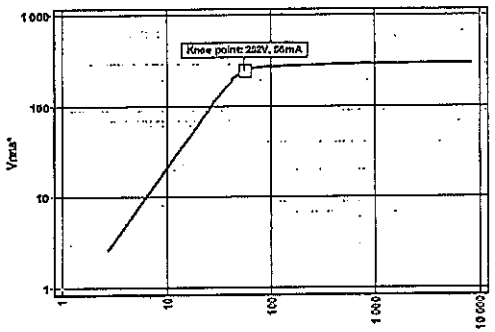
S2

[mA]
4558.2
2318.3
41.64
26.64
11.05
7.38
6.01
5.09
4.35
3.47
2.9
2.36
1.73
0.93
0.12



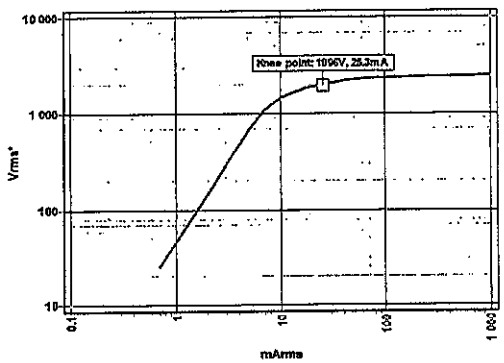
Winding 3S1-3S2

[V]	[mA]
308.5	8136
305.2	2980.3
302.2	1628.8
296.3	679.5
284.4	161.04
276.8	95.13
268.6	68.11
263.4	61.8
244.6	52.54
225.7	47.91
206.8	43.39
150	34.58
92.4	25.35
34.3	13.79
2.6	2.78



Winding 4S1-4S2

[V]	[mA]
2479.1	981.2
2472.2	758.1
2440.5	369.77
2368.9	127.27
2269.8	55.65
2195.4	43.02
2010.7	26.03
1823.9	17.24
1647.4	12.76
1463.9	10.06
1273	8.35
888.2	6.07
517.8	4.32
148.8	2.02
25.3	0.7



*) Average rectifier effective value.

Measurement of windings' resistance

Windings' resistance of current part:

	R (24 °C)	Rct (75 °C)
P1-P2 range 300A	566.0 μΩ	715.5 μΩ
P1-P2 range 600A	313.0 μΩ	375.7 μΩ
1S1-1S2	0.383 Ω	0.459 Ω
2S1-2S2	Ω	Ω
3S1-3S2	0.423 Ω	0.508 Ω
4S1-4S2	9.160 Ω	10.996 Ω

distance of voltage part:

	R (24 °C)	Rct (75 °C)
	kΩ	kΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ
	mΩ	mΩ

OG-4 16-06

Przasnysz, 2014-05-16

ANNEX 4 Documentations delivered by orderer

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 091/2013 (EN)
(acc. to ISO/IEC 17050-1)

Manufacturer: ABB Sp. z o.o. Dept. in Przasnysz

Address: Str. Leszno 59
06-300 Przasnysz / POLAND

Product: Combined Instrument Transformer PVA 145a

Above mentioned product comforms with the following standard :

Standard	Title	Edition/Date
IEC 61869 - 4	Combined Instrument Transformers	2013

Additional Information:
Serial numbers: **2GKP013K1486144;**

Place and date of issue of declaration

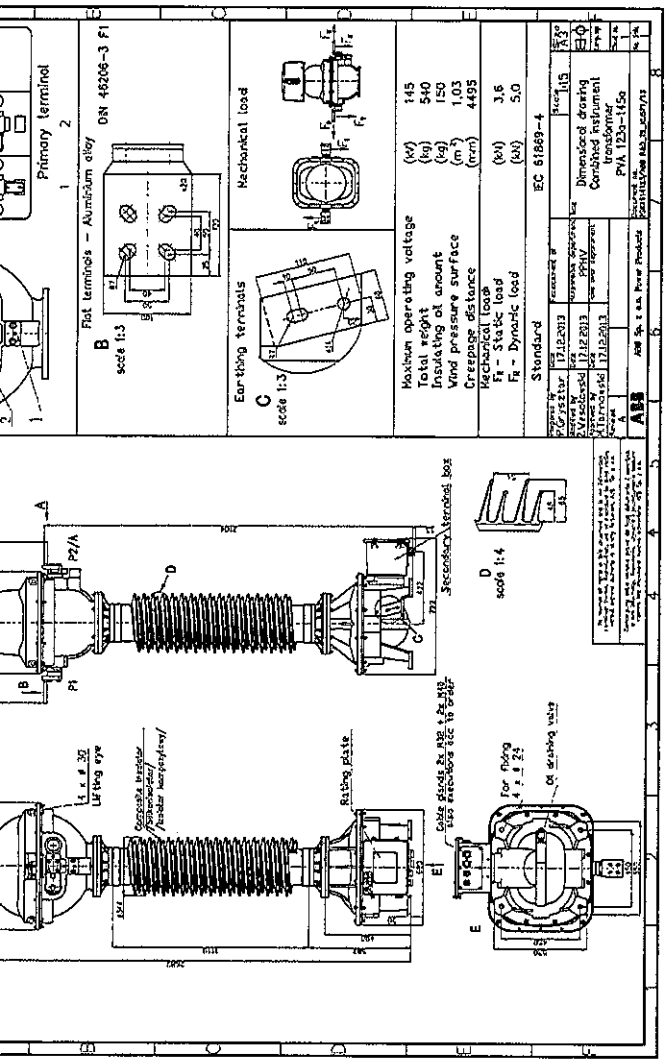
Przasnysz 13.01.2014

ABB
ABB Sp. z o.o.
ul. Żegańska 1, 04-713 Warszawa
NIP: 526-030-44-64; PL 526030464
Regon 010017166
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
tel. (22) 223 8921, fax (22) 223 8958
(9)

Referent ds. Realizacji Zamowien
ABB Sp. z o.o.
Oddział w Przasnyszu

Krzysztof Lubecki

(Name) (Signature)



ABB

Combined Instrument Transformer

Type	PVA 145a				
Insulation level	145/275/650 kV	Standard	IEC 61869-4	fn	50 Hz
Oil type	Nytro Libra	Weight / Oil weight	540 / 150 kg	Temp. range	-50°C ÷ +40°C
S/N	2GKP013K1486144	Voltage factor	1,9Un/8h	Ue	0,2 mV/kA

CURRENT PART

K_n 300-600 / 5-1-5-1 A/A

I_{th}/1s 40-40 kA I_{dyn} 100-100 kA

I_{cth} 360-720 A

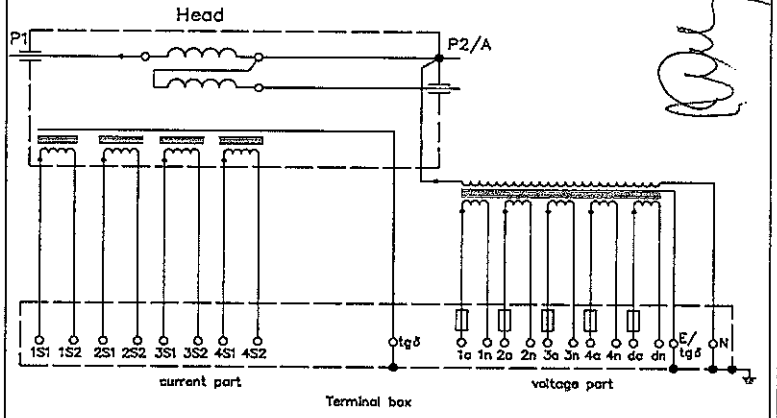
	1S1-1S2	2S1-2S2	3S1-3S2	4S1-4S2	5S1-5S2	6S1-6S2
A	5	1	5	1		
VA	40	30	60	120		
Kl.	0,2	0,5	5P	10P		
FS/ALF	5	10	20	15		
Ext.%	120	120				

VOLTAGE PART

A-N 132:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	110:√3	110:√3	110:√3	110:√3	110
VA	0->10	25	25	40	100
Kl.	0,1	0,1	0,1/3P	1/3P	1,0
VAsn	1000	1000	1000	1000	450

Transportation Vertical / Horizontal



Instrument transformer electrical diagram

ATTENTION!

1. HIGH VOLTAGE AT OPEN CURRENT SECONDARY TERMINALS XS1 – XS2
2. DURING INSTRUMENT TRANSFORMER OPERATION TERMINALS: N, E/tgδ, tgδ MUST BE EARTHED
3. AFTER THREE WINDINGS da - dn ARE CONNECTED IN BROKEN DELTA THE CIRCUIT SHOULD BE EARTHED IN ONE POINT ONLY

HIGH VOLTAGE LABORATORY

INSTYTUT ENERGETYKI

LABORATORY ACCREDITED
BY THE POLISH CENTRE FOR ACCREDITATION

Accreditation Certificate of Testing Laboratory
No AB 272

AB 272

TEST REPORT

No. EWN/145/E/13

Type test, special tests and additional tests

of combined transformers type PVA123a and PVA145a

manufactured by ABB sp. z o.o.

TESTS REPORTS No EWN/145/E/13

TEST OBJECT:	**Combined transformers type PVA123a and PVA145a**
TEST ORDERED BY:	**ABB Sp. z o.o. 04-713 Warszawa, ul. Żegańska 1**
ORDER NO:	**4500513518 – 21.10.2013**
SCOPE OF TEST:	**Type test, special tests and additional tests**
PROCEDURA OF TESTS:	**in accordance with standards: PN-EN/IEC 61869-1, PN-EN/IEC 61869-2, PN/EN/IEC 61869-3, IEC 61869-4**
DATE OF TESTS:	**November - December 2013**
TESTS RESULTS:	**Positive – details are presented in following parts of report** Test results refer to tested objects only.

TEST PERFORMERS:	**Michał MOLAS, M.Sc.E.E.**	SIGNATURE
	Jan SZOKALSKI, M.Sc.E.E.	SIGNATURE
AUTHORIZATION:	**Jerzy MIKOŁAJCZYK M.Sc.E.E.**	SIGNATURE
HEAD OF HIGH VOLTAGE DEPARTMENT:	**January L. MIKULSKI, Prof., Dr. hab. E. E.**	SIGNATURE

Warsaw, January 2014

CONTENTS

ain:
29 numbered pages
esented:
5 drawings
1 photography
7 numbered tables
4 annexes
and non numbered diagrams and tables

1. COMPETENCE OF THE LABORATORY

The High Voltage Laboratory of Institute of Power Engineering (IEn) in Warsaw is in possession of accreditation issued by the Polish Centre for Accreditation (Accreditation Certificate of Testing Laboratory No AB 272) concerning following tests:

Insulators and insulator strings	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests – radio interference measurements
Distribution substations	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests – radio interference measurements
Circuit breakers, disconnectors	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests – radio interference measurements
Insulators	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests – radio interference measurements
Current and voltage transformers	**– lightning and switching impulse tests** **– power-frequency voltage 50 Hz tests**
Power transformers	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests
Lightning arresters and limiters	– lightning and switching impulse tests – power-frequency voltage 50 Hz tests
Cables and cable fittings	– lightning and switching impulse tests

Note! Tests described in sub-clauses 4.3, 4.6, 4.7 of this Report don't comply with the scope of Laboratory accreditation.

This Report concerns test results obtained in other competent laboratories - (see Annex 2) :

- Factory Laboratory of ABB sp. z o.o. in Przasnysz – calibration unit in cooperation with Central and Regional Office of Measures in Warsaw - determination of errors and test in range of type tests at supervision of representative of High Voltage Laboratory of Institute of Power Engineering in Warsaw.

TION OF TEST OBJECT

d objects were two types of combined transformers PVA123a and PVA145a
ABB sp. z o.o. 04-713 Warszawa, Żegańska 1 St. (Fabryka Aparatury Wysokich i
06-300 Przasnysz, Leszno 59 St.), with the following parameters:

A123a
KP013K1486138

ted primary voltage	$110/\sqrt{3}$ kV
ted primary current	50 -100- 200 A
ted frequency	50 Hz
ted insulation level	126/230/550 kV
ted short-time thermal current	40-63-63 kA
ted dynamic current	100-158-158 kA
nimum creepage distance	3800 mm (composite insulator)

143/13
rcelain insulator, creepage distance 4495 mm (annex 1,
awing 2GKK614123/ABB R&D_TS_KU570/13)
odel of the transformer with disassembled winding

142/13
mposite insulator, creepage distance 4495 mm (annex 1,
awing 2GKK614121/ABB R&D_TS_KU570/13)
odel of the transformer with disassembled winding

VA145a
GKP013K1486145

ated primary voltage	$132/\sqrt{3}$ kV
ated primary current	150-300 A
ated frequency	50 Hz
ated insulation level	145/275/650 kV
ated short-time thermal current	20-20 kA
ated dynamic current	50-50 kA
linimum creepage distance	4495 mm (composite insulator)

VA145a
GKP013K1486144

ated primary voltage	$132/\sqrt{3}$ kV
ated primary current	300-600 A
ated frequency	50 Hz
ated insulation level	145/275/650 kV
ated short-time thermal current	40-40 kA

The identification of the objects was made on the basis of the following documents attached to this report:

- Manufacturer Conformity Declaration (applies only for objects for electrical tests: prototype 1 - 2GKP013K1486138, prototype 6 - 2GKP013K1486144, prototype 7-2GKP013K1486145) – annex 1,
- Dimension drawings, rating plates, electrical diagrams – annex 1,
- Routine test reports of combined instrument transformers – annex 2.

3. AGREED SCOPE OF TESTS

According to ordered tests the type test and selected special test were performed according to the following standards:

- IEC 61869-1:2007 „Instrument transformers - Part 1: General requirements" (equiv. with: PN-EN 61869-1:2007 "Przekładniki – Część 1: Wymagania ogólne")
- IEC 61869-2:2012 „Instrument transformers - Part 2: Additional requirements for current transformers" (equiv. with: PN-EN 61869-2:2013 "Przekładniki – Część 2: Wymagania szczegółowe dotyczące przekładników prądowych")
- IEC 61869-3:2011 „Instrument transformers - Part 3: Additional requirements for inductive voltage transformers" (equiv. with: PN-EN 61869-3:2011 "Przekładniki – Część 3: Wymagania szczegółowe dotyczące przekładników napięciowych indukcyjnych")
- IEC 61869-4:2013 „Instrument transformers - Part 4: Additional requirements for combined transformers"

On request of ordering party the additional special test were performed. List of the performed tests are contained in Table 1.

During the tests mentioned above at Factory Laboratory of ABB sp. z o.o. in Przasnysz Leszno 59 Street, determination of errors of transformer was performed to prove the positive results of consecutive tests. The complete tests were performed according to mentioned above standards. The tests were supervised by representatives of High Voltage Laboratory of Institute of Power Engineering in Warsaw in purpose to prove results of tests (Annex 2).

Table 1: List of performed tests.

erformed tests	Prototype (SN)	Requirement
mpulse test	1(2GKP013K1486138) 6(2GKP013K1486144)	61869-4, p.7.2.3
or outdoor ers	3(86143/13) 4(86142/13)	61869-1, p.7.2.4
fluence test	1(2GKP013K1486138) 7(2GKP013K1486145)	61869-4,p.7.2.6.401 p.7.2.6.402
ent of the radio e voltage (RIV)	6(2GKP013K1486144)	61869-1, p.7.2.5.1
TS		
mpulse test on the nding	1(2GKP013K1486138) 6(2GKP013K1486144)	61869-1, p.7.4.1
l overvoltage nt	1(2GKP013K1486138) 6(2GKP013K1486144)	61869-1, p.7.4.4
TESTS		
apacitor test	1(2GKP013K1486138)	C=6μF, U=1,1·√2·110/√3 kV No breakdown and temperature rise over 65 K.

TESTS

ulse test

e in test arrangement of surge generator type Haefely 5 MV, 375 kJ. Equivalent nown in the Figure 1. The test was performed on standardized lightning impulse se of test was checking internal insulation of transformer. The influence of on on test voltage value was not taken into consideration.

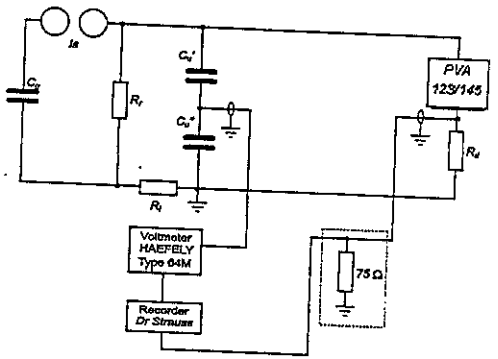


Fig. 1 Equivalent circuit diagram of test arrangement for lightning impulses:
$C_g \approx 0{,}125$ μF, $C_r \approx 1{,}2$ nF, $R_t = 175\ \Omega$, $R_r = 600\ \Omega$, $R_d = 8{,}95\ \Omega$.
Measurement uncertainty: 1,5 % of the measured value (confidence interval 95%, k=2).

The Lightning impulse test was performed jointly with chopped impulse test on the primary winding (clause 4.5 of this Report). Test conditions are specified in the table 2:

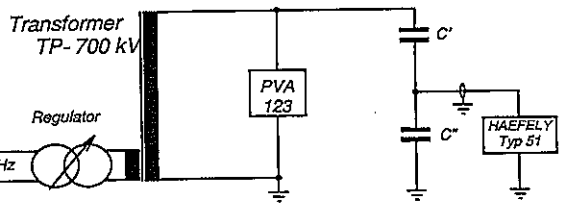
Table 2: Lightning impulse voltage test conditions.

Prototype	1 (2GKP013K1486138)	6 (2GKP013K1486144)
Full impulse test voltage [kV]	550	650
Chopped impulse test voltage [kV]	1,15 · 550 = 632,5	1,15 · 650 = 747,5
Sequence of impulses	Positive polarity – 15 full impulses; Negative polarity – 1 full impulse, 2 chopped impulses, 14 full impulses.	
Registration	Transients of test voltage and current flowing through the whole transformer.	

: registered during the tests of the prototypes 1(2GKP013K1486138) and 6
1486144) don't indicate any failures of the transformers' insulation.
of the accuracy verification before and after the lightning impulse test of the
s (annex 2) don't indicate significant changes of the transformers'
characteristics.
positive.

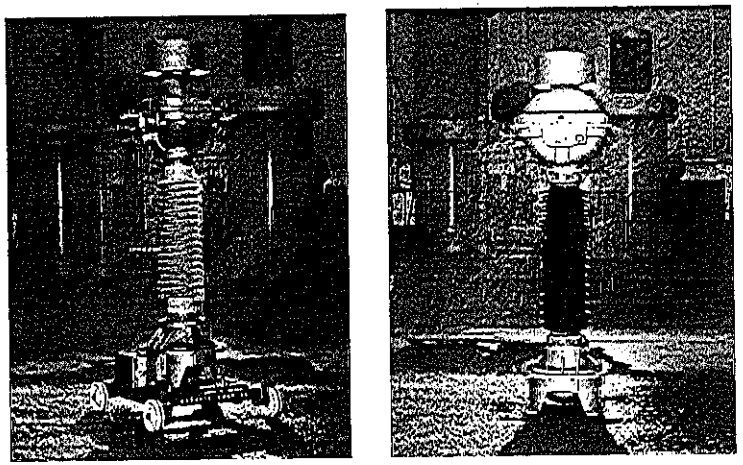
scillograms of all applied impulses are shown in Annex No. 3 of this Report.

outdoor transformers
was performed in arrangement of test transformer type TuR 700kV, 0,5A.
: diagram is presented in the Figure 2.



it circuit diagram for power frequency voltage 50 Hz: C = 200 pF (C' in series with C").
ement uncertainty: 1,5 % of the measured value (confidence interval 95%, k=2).

is performed on transformers prototypes with disassembled winding (prototypes 3-
- 86142/12; presented in the photography 1). All external elements of transformers,
uence test results were identical to the complete transformer. The purpose of the
: withstanding of porcelain housing (prototype 3) and composite housing (prototype
posed to the artificial rain conditions.



Phot. 1: Wet test of prototypes 3 (86143/13) and 4 (86142/13) at power frequency voltage 50 Hz.

In each case the test voltage U=275 kV (corresponding to the equipment with Um=145 kV) was applied for 1 minute.

During wet test for outdoor transformers the transformer was wetting by artificial rain at parameters:

- vertical component of precipitation H_v = 1,4 mm/min
- horizontal component of precipitation H_h = 1,4 mm/min
- water electrical resistivity ρ= 101÷103 Ωm

The test voltage was corrected according to density of air.

During the tests no flashover or failure of insulation could be observed.

Test result - positive.

Electric strength of the inner insulation does not depend on atmospheric conditions and it was tested during routine test at ABB's Factory Laboratory (Annex 2).

luence test

influence of the current transformer on the voltage transformer

e 1- 2GKP013K1486138

surements were performed by exciting in primary current winding with range
rrent part of combined transformer 50 Hz current at value:

$$2 \cdot I_n = 400 \text{ A}$$

e to current transformer had the shape of a horizontal rectangular loop with
approximately 3500 x 1100mm. Secondary windings of current transformer and
of voltage of transformer were short-circuited. On all windings of voltage part of
former which are burdened by 15 VA were measured in turn interference voltage
KEITHLEY type 2001.

1a-1n	2a-2n	3a-3n	4a-4n	da-dn
15	15	15	15	15
0,150	0,139	0,118	0,111	0,089

rameters were calculated:

(0,8 U_{SN}) change of voltage error (at 80% voltage of secondary winding for measurement)

(0,02 U_{SN}) change of voltage error (at 2% voltage of secondary winding for protection)

change of phase displacement (in min.)

ated voltage [V]

ble 3: Calculated voltage errors and phase displacements – prototype 1.

ng	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
N	80%	80%	2%	2%	2%
%]	0,00032	0,00030	0,01022	0,00961	0,01335
in]	0,0112	0,0104	0,3515	0,3307	0,4592

nality between induced voltage (interfere) and current in current transformer (in

150 mV / 0,400 kA ≡ **0,375 mV/kA**

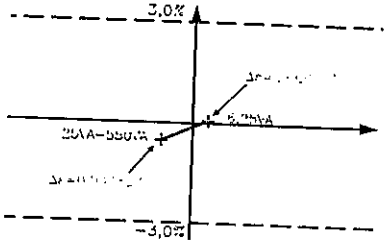
The maximal error of voltage transformer was evaluated by summarize mentioned above errors originated from influence of current path on voltage path together with extreme values of errors measured during routine test at $U = 0{,}8 \cdot U_n \div 1{,}2 \cdot U_n$ (Report No. 2GKP013K1486138 – 12.11.2013, Annex No. 2 of hereby Report)

Below are presented chosen results of calculation in analytic and graphic form (for maximal errors).

Maximal possibly voltage error of measurement winding
1a-1n ($U = 0{,}8 \cdot U_n$)

$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0{,}517\% + 0{,}00032\% = 0{,}517\%$

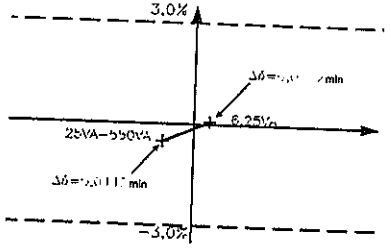
$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0{,}075\% + 0{,}00032\% = 0{,}075\%$



Maximal possibly phase displacement of measurement winding 1a-1n ($U = 0{,}8 \cdot U_n$)

$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = 7{,}1 \text{ min} + 0{,}0112 \text{ min} = 7{,}1 \text{ min}$

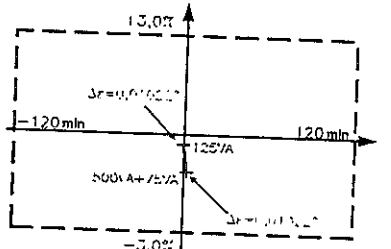
$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = 3{,}5 \text{ min} + 0{,}0112 \text{ min} = 3{,}5 \text{ min}$



Maximal possibly voltage error of winding for protection 3a-3n ($U = 0{,}02 \cdot U_n$)

$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 1{,}151\% + 0{,}01022\% = 1{,}161\%$

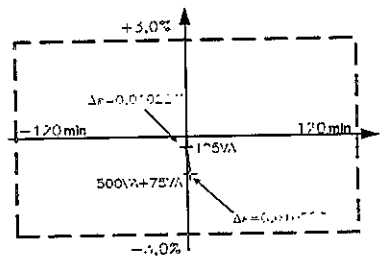
$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0{,}305\% + 0{,}01022\% = 0{,}315\%$



phase displacement of winding
3n (U=0,02·U_n)

1,151% + 0,01022% = 1,161%

0,305% + 0,01022% = 0,315%



hat errors derived from influence of current path on voltage path of nsformer PVA123a (prototype 1- 2GKP013K1486138) don't cause loss of properties (loss of accuracy class) for all secondary voltage windings . positive.

7 - 2GKP013K1486145

rements were performed by exciting in primary current winding with range rent part of combined transformer 50 Hz current at value:

$$1{,}5 \cdot I_n = 450 \text{ A}$$

to current transformer had the shape of a horizontal rectangular loop with pproximately 3500 x 1100mm. Secondary windings of current transformer and of voltage of transformer were short-circuited. On all windings of voltage part of rmer which are burdened by rated burden (winding da-dn were burdened by 15 red in turn interference voltage using instrument KEITHLEY type 2001.

1a-1n	2a-2n	3a-3n	4a-4n	da-dn
100	100	100	100	15
0,336	0,388	0,405	0,462	0,611

arameters were calculated:

/(0,8 U_{SN}) change of voltage error (at 80% voltage of secondary winding for measurement)

/(0,02 U_{SN}) change of voltage error (at 2% voltage of secondary winding for protection)

where:

U_{SN} – secondary rated voltage [V]

Tabele 4: Calculated voltage errors and phase displacements – prototype 1.

Winding	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
x U_{SN}	80%	80%	2%	2%	2%
$\Delta\varepsilon_V$ [%]	0,00066	0,00076	0,03189	0,03637	0,00208
$\Delta\delta_V$ [min]	0,0227	0,0263	1,0969	1,2512	0,0717

Factor of proportionality between induced voltage (interfere) and current in current transformer (in mV/kA)

$p < U_V/(1{,}5 \cdot I_N) = 1{,}2512 \text{ mV} / 0{,}450 \text{ kA} \cong \mathbf{2{,}78 \text{ mV/kA}}$

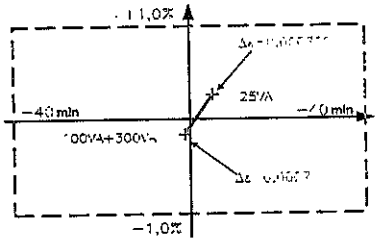
The maximal error of voltage transformer was evaluated by summarize mentioned above errors originated from influence of current path on voltage path together with extreme values of errors measured during routine test at $U = 0{,}8 \cdot U_n \div 1{,}2 \cdot U_n$ (Report No. 2GKP013K1486145 – 04.12.2013, Annex No. 2 of hereby Report)

Below are presented chosen results of calculation in analytic and graphic form (for maximal errors).

Maximal possibly voltage error of measurement winding
2a-2n ($U = 0{,}8 \cdot U_n \div 1{,}2 \cdot U_n$)

$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = \mathbf{0{,}163\% + 0{,}00076\% = 0{,}163\%}$

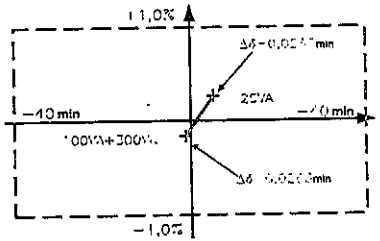
$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = \mathbf{0{,}266\% + 0{,}00076\% = 0{,}266\%}$



Maximal possibly phase displacement of measurement winding 2a-2n ($U = 0{,}8 \cdot U_n$)

$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = \mathbf{1{,}1 \text{ min} + 0{,}0263 \text{ min} = 1{,}1 \text{ min}}$

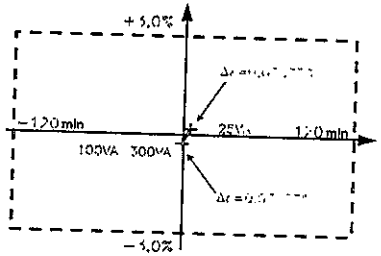
$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = \mathbf{5{,}2 \text{ min} + 0{,}0263 \text{ min} = 5{,}2 \text{ min}}$



ply voltage error of winding for
n (U=0,02·U_n)

= 0,261% + 0,03637% = 0,297%

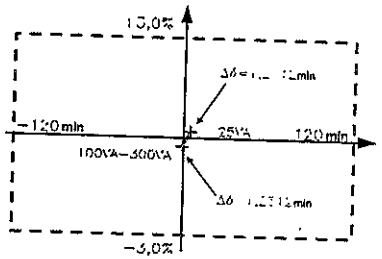
= 0,179% + 0,03637% = 0,215%



ly phase displacement of winding
-4n (U=0,02·U_n)

= 1,0 min + 1,2512 min = 2,25 min

= 4,6 min + 1,2512 min = 5,85 min



that errors derived from influence of current path on voltage path of nsformers PVA145a (prototype 7- 2GKP013K1486145) don't cause loss of properties (loss of accuracy class) for all secondary voltage windings . ositive.

influence of the voltage transformer on the current transformer

was performed by applying two value of voltage of power frequency 50 Hz to the er primary winding of combined transformer:

otype 1 – PVA123a	Prototype 7 – PVA145a
1,9 · 110/$\sqrt{3}$ kV = 121 kV	U = 1,9 · 132/$\sqrt{3}$ kV = 145 kV
1,2 · 110/$\sqrt{3}$ kV = 76 kV	U = 1,2 · 132/$\sqrt{3}$ kV = 91 kV

ondary windings of current transformer were measured interfere voltages U_i. l current In = 5 A were burdened by resistor R = 4 Ω and winding with rated

current In = 1 A were burdened by resistor R = 100 Ω.. Measurements were performed using instrument KEITHLEY type 2001 was 1 μV.

For each of windings were done two measurements of interfere voltage U_i, with earthed input terminal or input terminal. The calculation were performed:

- value of interfere current $I=U_i/R$
- change of measured current error (at 5% of rated current) $\Delta\varepsilon_i=(U_i \cdot 100)/(R \cdot 0{,}05\ I_n)$
- change of measured current error (at 100% of rated current) $\Delta\varepsilon_i=(U_i \cdot 100)/(R \cdot I_n)$
- change of phase displacement (in minutes) $\Delta\delta_i=\Delta\varepsilon_i \cdot 34{,}4$

Prototype 1 - 2GKP013K1486138

Test results and calculated values are present in tables below.

Tested winding 1s1-1s2 **earthed 1s1**

x U_N	U_i (R=4 Ω)	$I=U_i/R$	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	1,960	0,490	**0,196**	**6,74**
1,2	1,030	0,258	0,103	3,54

Tested winding 1s1-1s2 **earthed 1s2**

x U_N	U_i (R=4 Ω)	$I=U_i/R$	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	1,870	0,468	0,187	6,43
1,2	1,070	0,268	0,107	3,68

Tested winding 2s1-2s2 **earthed 2s1**

x U_N	U_i (R=100 Ω)	$I=U_i/R$	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	10,830	0,108	**0,217**	**7,45**
1,2	5,440	0,054	0,109	3,74

2s1-2s2 earthed 2s2

U_i (R=100 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
8,810	0,088	0,176	6,06
5,580	0,056	0,112	3,84

3s1-3s2 earthed 3s1

U_i (R=4 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
0,690	0,173	**0,003**	**0,12**
0,070	0,018	0,000	0,01

3s1-3s2 earthed 3s2

U_i (R=4 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
0,480	0,120	0,002	0,08
0,100	0,025	0,001	0,02

4s1-4s2 earthed 4s1

U_i (R=100 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
1,540	0,015	0,002	0,05
0,890	0,009	0,001	0,03

4s1-4s2 earthed 4s2

U_i (R=100 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
1,590	0,016	**0,002**	**0,05**
0,940	0,009	0,001	0,03

5s1-5s2 earthed 5s1

U_i (R=100 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
0,710	0,007	**0,001**	**0,02**

Tested winding 5s1-5s2 earthed 5s2

x U_N [-]	U_i (R=100 Ω) [mV]	I=U_i/R [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
1,9	0,490	0,005	0,000	0,02
1,2	0,120	0,001	0,000	0,00

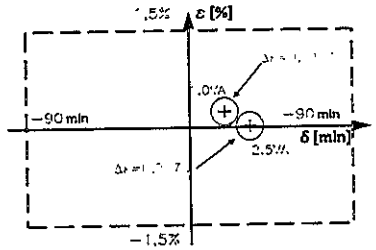
Current transformer maximal error of combined transformer was evaluated by summarize mentioned above errors originated from influence voltage path on current path together with extreme values of errors measured during routine test at $I = 0{,}05 \cdot I_n \div 2 \cdot I_n$ (Report No. 2GKP013K1486138 – 12.11.2013, Annex No. 2 of hereby Report).

Below are presented chosen results of calculation in analytic and graphic form (for maximal errors).

Maximal possibly current error of winding for measurement 2S1-2S2 ($I = 0{,}05 \cdot I_n \div 2 \cdot I_n$)

$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0{,}024\% + 0{,}217\% = 0{,}241\%$

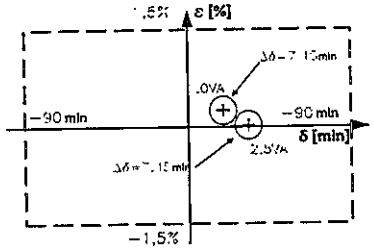
$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0{,}252\% + 0{,}217\% = 0{,}469\%$



Maximal possibly phase displacement of for measurement 2S1-2S2 ($I = 0{,}05 \cdot I_n \div 2 \cdot I_n$)

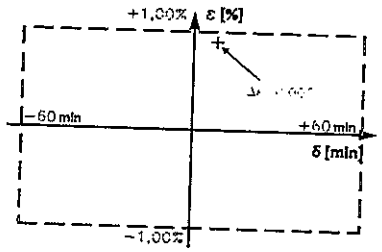
$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = 33{,}2 \text{ min} + 7{,}45 \text{ min} = 40{,}65 \text{ min}$

$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = 19{,}3 \text{ min} + 7{,}45 \text{ min} = 26{,}75 \text{ min}$



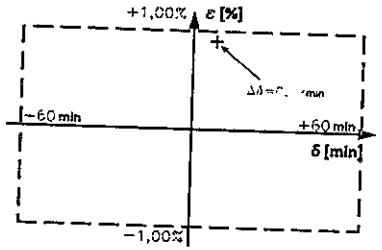
ly current error of winding for
3S2 (I = 0,05·I_n÷2·I_n)

l = 0,896% + 0,003% = 0,899%



y phase displacement of winding
1-3S2 (I = 0,05·I_n÷2·I_n)

= 8,3 min + 0,12 min = 8,42 min



t errors derived from influence of voltage path on current path of combined
A 123a (prototype 1- 2GKP013K1486138) not cause loss of metrological
f accuracy class) for all secondary voltage windings .

tive.

- 2GKP013K1486145

nd calculated values are present in tables below.

s1-1s2 **earthed 1s1**

U_i (R=4 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[mV]	[mA]	[%]	[min]
0,540	0,135	0,054	1,86
0,136	0,034	0,014	0,47

Tested winding 1s1-1s2 **earthed 1s2**

x U_N	U_i (R=4 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	0,599	0,150	**0,060**	**2,06**
1,2	0,346	0,087	0,035	1,19

Tested winding 2s1-2s2 **earthed 2s1**

x U_N	U_i (R=100 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	0,766	0,008	0,001	0,03
1,2	0,410	0,004	0,000	0,01

Tested winding 2s1-2s2 **earthed 2s2**

x U_N	U_i (R=100 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	2,990	0,030	**0,003**	**0,10**
1,2	1,970	0,020	0,002	0,07

Tested winding 3s1-3s2 **earthed 3s1**

x U_N	U_i (R=4 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	1,366	0,342	**0,007**	**0,23**
1,2	0,173	0,043	0,001	0,03

Tested winding 3s1-3s2 **earthed 3s2**

x U_N	U_i (R=4 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	0,564	0,141	0,003	0,10
1,2	0,364	0,091	0,002	0,06

Tested winding 4s1-4s2 **earthed 4s1**

x U_N	U_i (R=100 Ω)	I=U_i/R	$\Delta\varepsilon_i$	$\Delta\delta_i$
[-]	[mV]	[mA]	[%]	[min]
1,9	1,930	0,019		

ls1-4s2 earthed 4s2

U_i (R=100 Ω) [mV]	$I=U_i/R$ [mA]	$\Delta\varepsilon_i$ [%]	$\Delta\delta_i$ [min]
2,860	0,029	**0,003**	**0,10**
1,880	0,019	0,002	0,06

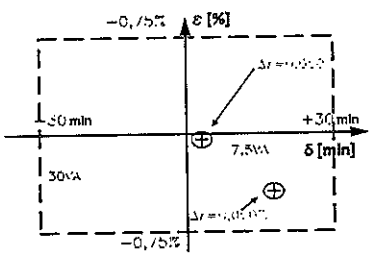
sformer maximal error of combined transformer was evaluated by summarize errors originated from influence voltage path on current path together with errors measured during routine test at $I = 0,05 \cdot I_n \div 2 \cdot I_n$
P013K1486145 – 04.12.2013, Annex No. 2 of hereby Report).

ted chosen results of calculation in analytic and graphic form
rs).

y current error of winding for
1-1S2 $(I = 0,05 \cdot I_n \div 2 \cdot I_n)$

= 0,441% + 0,060% = 0,501%

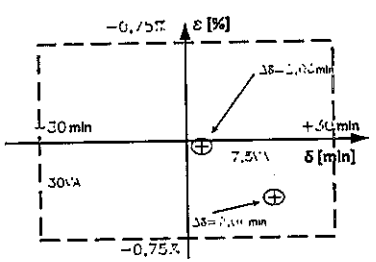
= 0,043% + 0,060% = 0,103%



y phase displacement of for
1-1S2 $(I = 0,05 \cdot I_n \div 2 \cdot I_n)$

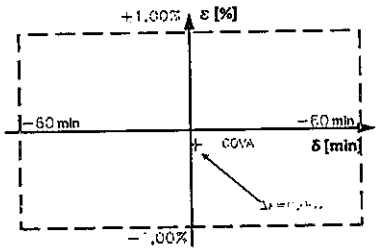
= 17,7 min + 2,06 min = 19,76 min

= 3,1 min + 2,06 min = 5,16 min



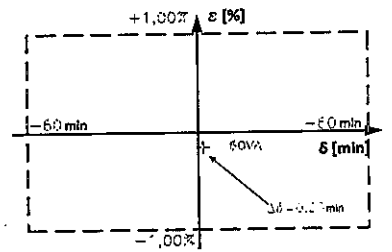
Maximal possibly current error of winding for protection 3S1-3S2 $(I = 0,05 \cdot I_n \div 2 \cdot I_n)$

$\pm\varepsilon_i' = |\varepsilon_i| + |\Delta\varepsilon_i| = 0,148\% + 0,007\% = 0,155\%$



Maximal possibly phase displacement of winding for protection 3S1-3S2 $(I = 0,05 \cdot I_n \div 2 \cdot I_n)$

$\pm\delta_i' = |\delta_i| + |\Delta\delta_i| = 1,7$ min + 0,23 min = 1,93 min



It was found that errors derived from influence of voltage path on current path of combined transformers PVA145a (prototype 7 - 2GKP013K1486145) don't cause loss of metrological properties (loss of accuracy class) for all secondary voltage windings .

Test result - positive.

4.4 Radio interference voltage measurement

According to the IEC 61869-1 RIV measurement was performed in a test circuit shown in the figure 3 (IEC/CISPR 18-2). Voltage value was measured on the resistance 300 Ω for the frequency 0,5 MHz. Before the measurement the test setup was calibrated using a stable signal generator, what resulted in estimation of the RIV correction value +24 dB. Measuring was done with a RIV meter LMZ-5. „Background noise level" was measured within the range of test voltage values 0 - 100 kV. Level of the radio interference voltage caused by the test setup, radio stations, etc. was less than

g to IEC 61869-1 Maximum level of the radio interference voltage shouldn't exceed
V for the test voltage value Up=1.1·$U_m/\sqrt{3}$ =92 kV (U_m=145 kV).
-5 radio interference voltmeter is a logarithmic scale meter: RIV_{dop} = 2500μV → 68
V).

e actual measurement voltage of 1,5· $U_m/\sqrt{3}$ was applied to the transformer for 30
n 10 seconds the voltage was decreased to 1,1· $U_m/\sqrt{3}$ and maintained for another
erwards the actual RIV level measurement was done.
lly the RIV level was measured as a function of rated test voltage value in range of
. Test voltage was lowered with a step of 0,1·Up from Up=1,1·$U_m/\sqrt{3}$ down to
3. Afterwards, with the same step value, the test voltage was raised and lowered
e was measured for the each of test voltage values, and for the last series of
voltage, the RIV level graph was drawn.
easurement was performed on the prototype 6 (2GKP013K1486144).

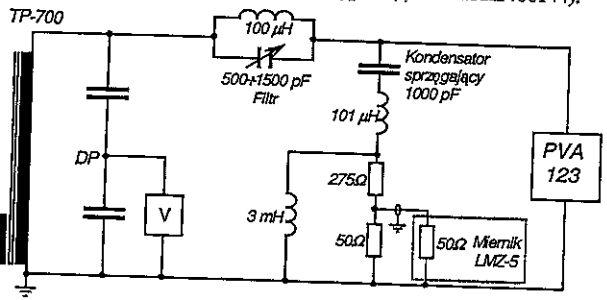


Fig. 3 Test arrangement for RIV measurement.

f measurements are presented in the table and diagram below.

Table 5: RIV measurement results.

[kV]	92	84	75	67	59	50	42	33	25
Uf	1,1	1	0,9	0,8	0,7	0,6	0,5	0,4	0,3
→	11,5	10	7	1	-5				
←	10,5	10	7	4	-7				
→	10,5	9	5,5	1	-8				
: [dB]	34,5	33,0	29,5	25,0	16,0				
[μV]	53,1	44,7	29,9	17,8					

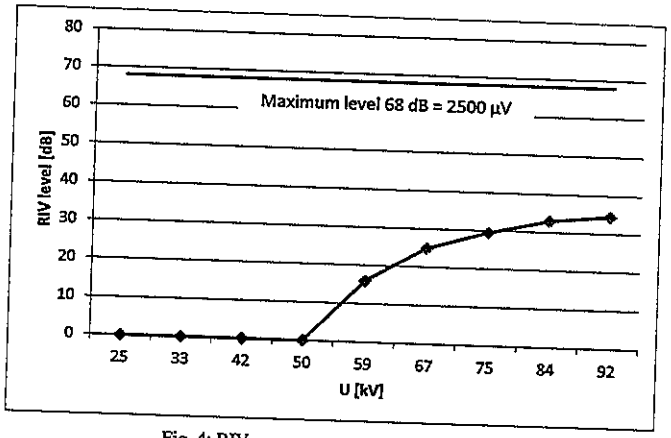


Fig. 4: RIV measurement results (diagram).

Measured Radio Interference Voltage RIV = 53,1 μV (34,5 dB) is much less than permissible level RIV_{perm} = 2500 μV (68 dB) for the tested transformer prototype 6 (2GKP013K1486144).
Test result - positive.

4.5 Chopped impulse test on the primary winding

Chopped Impulse Test was supplemented to Lightning Impulse test 1,2/50μs and was described in clause 4.1 of this Report.

Recorded oscillograms don't indicate insulation failure of the tested transformers.
Test result - positive.

Oscillograms of all applied impulses are presented in Annex No. 3 of this Report.

overvoltage measurement

the test of transformers prototypes 1 (2GKP013K1486138) and 6 44) impulse voltage was applied to the HV terminal. Maximal value of recorded which came in each secondary windings - both current and voltage. requirement of Standard for impulse 0,5/50 μs and value $U_m/\sqrt{3}$ the values of transmitted overvoltages can not exceed 1,6 kV. During all the transformer were applied lightning impulses at value ten times less, that is rning linear of phenomenon, registered overvoltages should have values less than absolute peak value). Wave shapes of impulses and transmitted overvoltage were ulse voltage measuring system Dr Strauss TR-AS 200-14.

f test are presented in the table below.

Table 6: Transmitted overvoltage measurement results.

Prototype 1 (2GKP013K1486138)		Prototype 6 (2GKP013K1486144)	
$U_p \approx 160$ kV ; $U_t \approx 16$ kV		$U_p \approx 190$ kV ; $U_t \approx 19$ kV	
Overvoltage value $U_{pp}/2$ [V]	Percent of permissible overvoltage [%]	Overvoltage value $U_{pp}/2$ [V]	Percent of permissible overvoltage [%]
33,50	20,9	47,66	29,8
33,01	20,6	44,63	27,9
35,87	22,4	55,98	35,0
42,21	26,4	66,13	41,3
57,63	36,0	40,02	25,0
82,71	51,7	93,96	58,7
35,68	22,3	103,30	64,6
95,93	60,0	101,50	63,4
58,59	36,6	86,20	53,9
43,54	27,2		

at for each of secondary winding of tested transformers (prototype 1 - 5138 and 6- 2GKP013K1486144) transmitted overvoltages don't exceed value is maximum permissible value.

sitive.

t registered impulses are present in Annex No. 4

4.7 Discharge capacitor test

Prototype 1 - 2GKP013K1486138

Discharge capacitor test consists of ten time discharged capacitor with capacitance C = 6 μV charged through combined transformer to voltage of value $U=1{,}1\cdot\sqrt{2}\cdot 110/\sqrt{3}$ kV ≈ 100 kV. Before tests and before each discharge the resistance of winding was measured and temperature rise were calculated.. The discharges was performed after 3 minutes, that is short as possibly time because charging capacitor and performing measurements. Additionally in purpose of checking transformer cooling the measurements of resistance of winding were performed and measurement value were used to calculation decrease of temperature during 15 minutes. Ambient temperature (initial temperature of transformer) was $T_0 = 5{,}8°C$.

Rise of temperature was calculated according to formula:

$$\Delta T = \frac{\Delta R}{Ro \cdot \alpha}$$

where: ΔR – increase of resistance of winding;

R_0 – resistance of winding before test;

α – temperature coefficient of resistance for copper (assumed α = 0,004)

Results of performed test are presented in the table 7 and diagram in the figure 5.

Table 7: Rise of the temperature during discharging test results.

t [min]	R [Ω]	ΔR [Ω]	ΔT [K]
0	16310	0	0,0
3	16450	140	2,1
6	16570	260	4,0
9	16700	390	6,0
12	16820	510	7,8
15	16920	610	9,4
18	17040	730	11,2
21	17170	860	13,2
24	17290	980	15,0
27	17410	1100	16,9
30	17540	1230	18,9
33	17400	1090	16,7
36	17270	960	14,7
39	17150	840	12,9

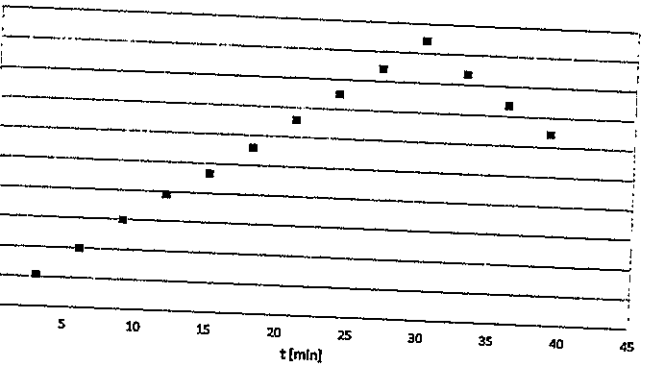


Fig. 5: Rise of the temperature of the transformer during discharging test C=6uF, U=100kV.

rise of temperature ΔT=18,9 K is not dangerous for insulation of combined
Maximal permissible rise of temperature in temperature-rise test is 65 K
51869-1, p. 6.4.1). This criterion can be applied to capacitor discharge test
re of the combined transformer during test was proper. After the test any
leakage could be observed. It was found that metrological properties of
sformer are comply assigned accuracy classes for separate windings and
es after tests are virtually identical to values measured before tests (No.
6138 – 20.12.2013 – Annex No. 2).
sitive.

5. LIST OF ANNEXES

Annex No. 1

Documents provided by ABB Sp. z o.o. used as base of identification of test object:

- Manufacturer Conformity Declaration No. 001/2014 (13.01.2014),
- Manufacturer Conformity Declaration No. 091/2013 (13.01.2014),
- Manufacturer Conformity Declaration No. 092/2013 (13.01.2014),
- Dimension drawing 2GKK614122/ABB R&D_TS_KU568/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU570/13 (17.12.2013),
- Dimension drawing 2GKK614121/ABB R&D_TS_KU570/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU571/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU572/13 (17.12.2013),
- Rating plate of transformer SN 2GKP013K1486138
- Rating plate of transformer SN 86142/13
- Rating plate of transformer SN 86143/13
- Rating plate of transformer SN 2GKP013K1486144
- Rating plate of transformer SN 2GKP013K1486145
- Electrical diagram of transformer SN 2GKP013K1486138
- Electrical diagram of transformer SN 86142/13
- Electrical diagram of transformer SN 86143/13
- Electrical diagram of transformer SN 2GKP013K1486144
- Electrical diagram of transformer SN 2GKP013K1486145

Annex No. 2

Reports of routine test and determination of errors of combined transformers type PVA123a and PVA145a performed in Factory Laboratory of ABB sp. z o.o.

- Tests before type test and special test (Measurements before type test and special tests)
  - Report No. 2GKP013K1486138 – 12.11.2013,
- Tests before type test and special test (Measurements before type test and special tests)
  - Report No. 2GKP013K1486144 – 18.11.2013,
- Tests before type test and special test (Measurements before type test and special tests)
  - Report No. 2GKP013K1486145 – 04.12.2013,
- Tests after lightning impulse test
  - Report No. 2GKP013K1486138 – 09.12.2013,
- Tests after lightning [illegible]

test. Impulse 1,2/50 μs, full and chopped:
test voltages and detection currents.
/145/E/13-1a – 20.11.2013.
/145/E/13-1b – 09.11.2013.

oltage measurement:
f measured overvoltages transmitted to the secondary windings.
/145/E/13-2a – 21.11.2013.
/145/E/13-2b – 13.11.2013.

ANNEX 1 for test report EWN/145/E/13

Documents provided by ABB Sp. z o.o. used as base of identification of test object:

- Manufacturer Conformity Declaration No. 001/2014 (13.01.2014),
- Manufacturer Conformity Declaration No. 091/2013 (13.01.2014),
- Manufacturer Conformity Declaration No. 092/2013 (13.01.2014),
- Dimension drawing 2GKK614122/ABB R&D_TS_KU568/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU570/13 (17.12.2013),
- Dimension drawing 2GKK614121/ABB R&D_TS_KU570/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU571/13 (17.12.2013),
- Dimension drawing 2GKK614123/ABB R&D_TS_KU572/13 (17.12.2013),
- Rating plate of transformer SN 2GKP013K1486138
- Rating plate of transformer SN 86142/13
- Rating plate of transformer SN 86143/13
- Rating plate of transformer SN 2GKP013K1486144
- Rating plate of transformer SN 2GKP013K1486145
- Electrical diagram of transformer SN 2GKP013K1486138
- Electrical diagram of transformer SN 86142/13
- Electrical diagram of transformer SN 86143/13
- Electrical diagram of transformer SN 2GKP013K1486144
- Electrical diagram of transformer SN 2GKP013K1486145

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 001/2014 (EN)
(acc. to ISO/IEC 17050-1)

cturer: ABB Sp. z o.o. Dept. in Przasnysz

: Str. Leszno 59
06-300 Przasnysz / POLAND

Combined Instrument Transformer PVA 123a

entioned product comforms with the following standard :

rd	Title	Edition/Date
9 - 4	Combined Instrument Transformers	2013

l information:
nbers: **2GKP013K1486138;**

date of issue of declaration

: 13.01.2014

ABB
ABB Sp. z o.o.
ul. Żegańska 1, 04-713 Warszawa
NIP: 526-030-44-84; PL 5260304484
Regon 010017168
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
tel. (22) 223 8921, fax (22) 223 8958
(9)

s. Realizacji Zamówień
ABB Sp. z o.o.
ział w Przasnyszu
rzata Jędrzewska

Kierownik ds. Zapewnienia ...
ABB Sp. z o.o.
Oddział w Przasnyszu
Krzysztof Lubnek

me) (Signature)

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 091/2013 (EN)
(acc. to ISO/IEC 17050-1)

Manufacturer: ABB Sp. z o.o. Dept. in Przasnysz

Address: Str. Leszno 59
06-300 Przasnysz / POLAND

Product: Combined Instrument Transformer PVA 145a

Above mentioned product comforms with the following standard :

Standard	Title	Edition/Date
IEC 61869 - 4	Combined Instrument Transformers	2013

Additional information:
Serial numbers: **2GKP013K1486144;**

Place and date of issue of declaration

Przasnysz 13.01.2014

ABB
ABB Sp. z o.o.
ul. Żegańska 1, 04-713 Warszawa
NIP: 526-030-44-84; PL 5260304484
Regon 010017168
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
tel. (22) 223 8921, fax (22) 223 8958
(9)

Referent ds. Realizacji Zamówień
ABB Sp. z o.o.
Oddział w Przasnyszu

Kierownik ds. Zapewnienia ...
ABB Sp. z o.o.
Oddział w Przasnyszu
Krzysztof Lubnek

(Name) (Signature)

ABB Sp. z o.o.	Declaration of conformity	ABB Sp. z o.o. Dept. in Przasnysz POLAND

DECLARATION OF CONFORMITY No. 092/2013 (EN)
(acc. to ISO/IEC 17050-1)

turer: ABB Sp. z o.o. Dept. in Przasnysz

Str. Leszno 59
06-300 Przasnysz / POLAND

Combined Instrument Transformer PVA 145a

entioned product comforms with the following standard :

ard	Title	Edition/Date
69 - 4	Combined Instrument Transformers	2013

al information:
umbers: **2GKP013K1486145;**

d date of issue of declaration

sz 13.01.2014

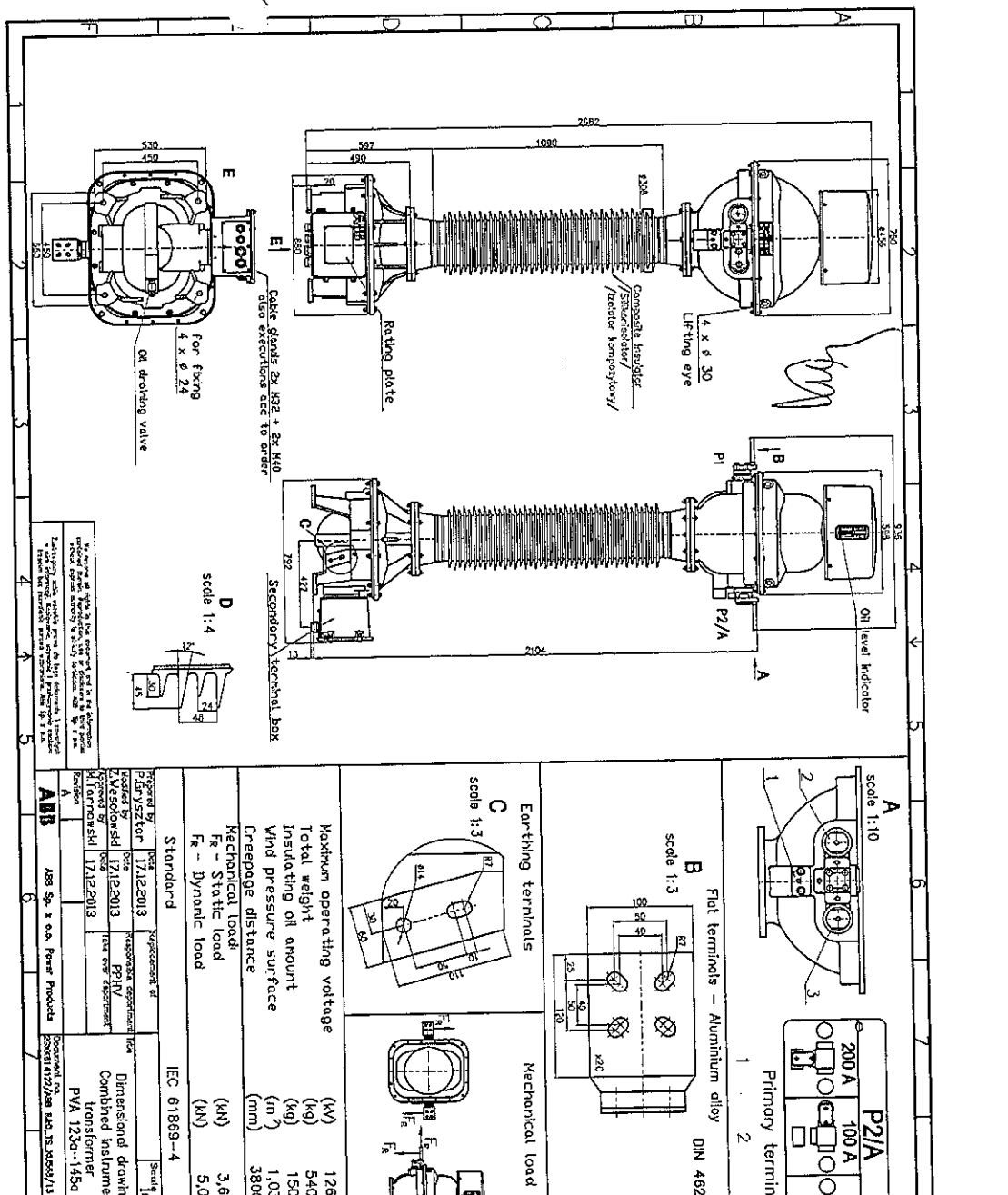
ABB Sp. z o.o.
ul. Żegańska 1, 04-713 Warszawa
NIP: 526-030-44-84; PL5260304484
Regon 010017168
ODDZIAŁ W PRZASNYSZU
ul. Leszno 59, 06-300 Przasnysz
tel. (22) 223 6921, fax (22) 223 6958
(9)

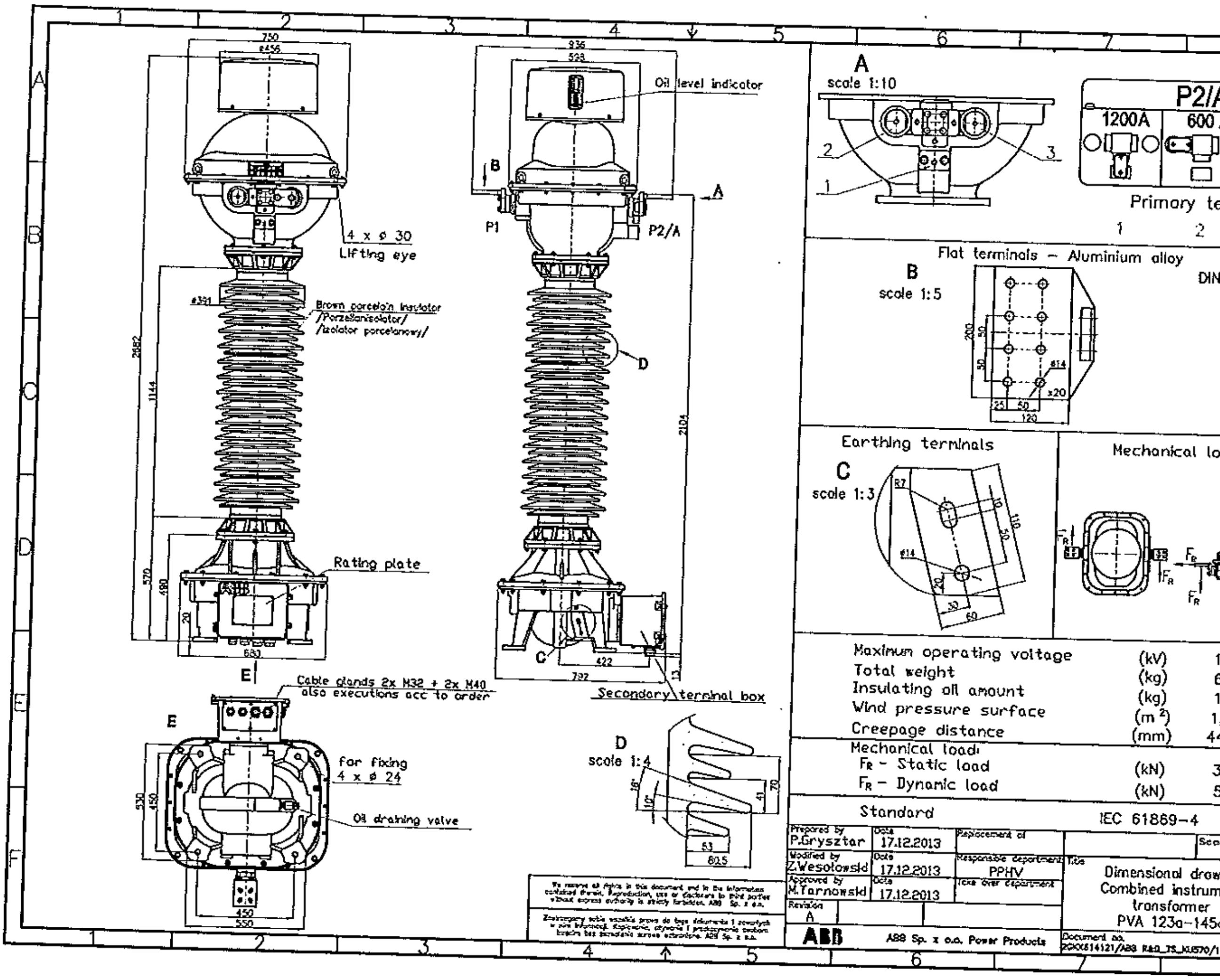
...dy. Realizacji Zamówień
ABB Sp. z o.o.
Oddział w Przasnyszu
...ałgorzata ...dziewska

(Name)

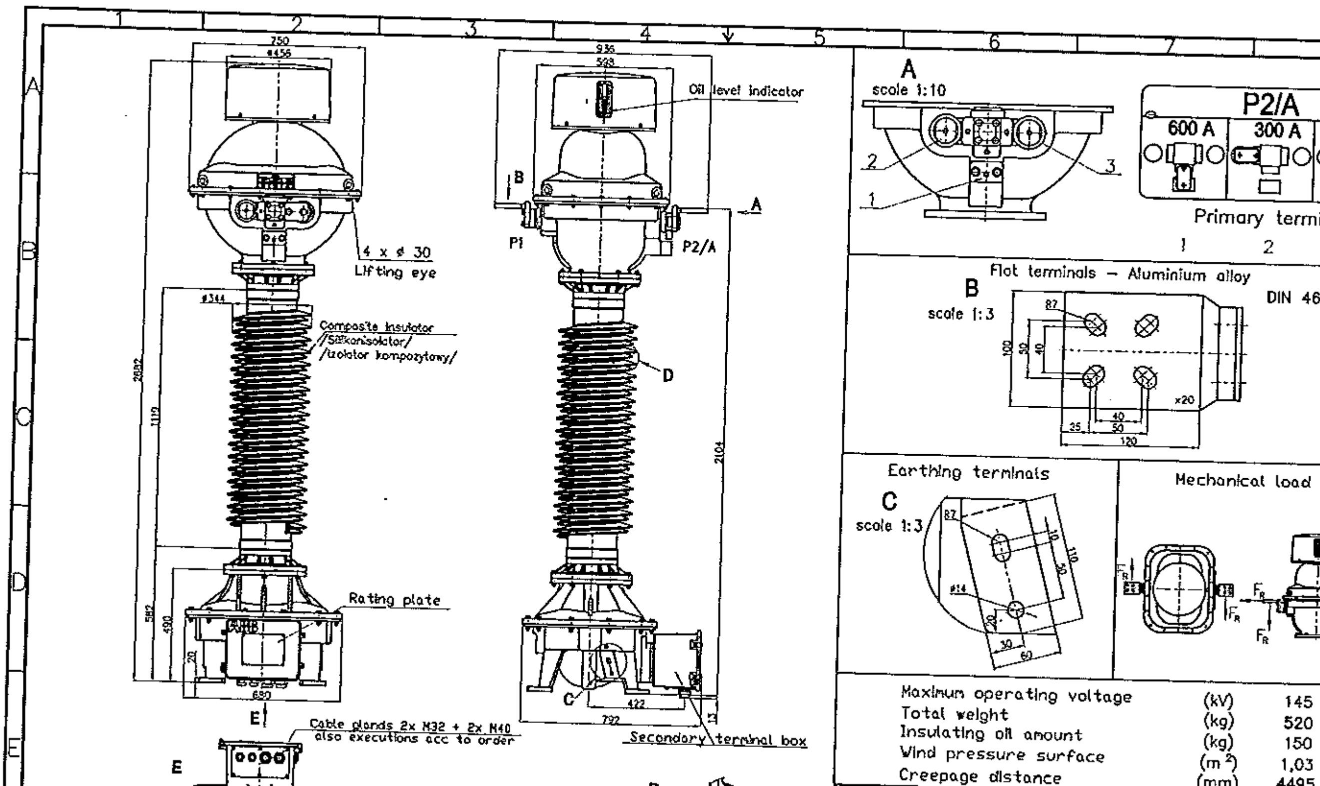
...lorownik ds. Zapewnienia Jakości
ABB Sp/z o.o.
Oddział w Przasnyszu
Krzysztof Łabecki

(Signature)

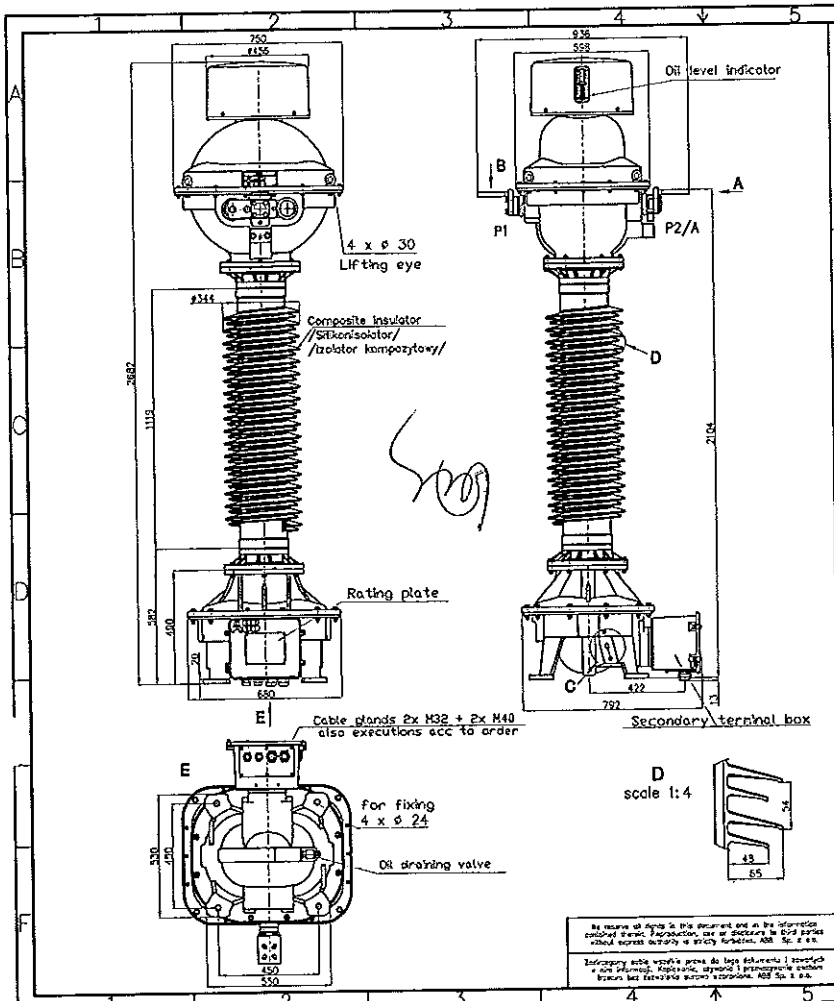




Oil level indicator
4 x ø 30
Lifting eye
Brown porcelain insulator
/Porzellanisolator/
/Izolator porcelanowy/
Rating plate
Cable glands 2x M32 + 2x M40
also executions acc to order
Secondary terminal box
for fixing
4 x ø 24
Oil draining valve
P1
P2/A
A
scale 1:10
P2/A
1200A
600
Primary te
Flat terminals - Aluminium alloy
B
scale 1:5
DIN
Earthing terminals
C
scale 1:3
Mechanical lo
D
scale 1:4
Maximum operating voltage (kV)
Total weight (kg)
Insulating oil amount (kg)
Wind pressure surface (m²)
Creepage distance (mm)
Mechanical load:
F_R - Static load (kN)
F_R - Dynamic load (kN)
Standard
IEC 61869-4
Prepared by P.Grysztar 17.12.2013
Modified by Z.Wesolowski 17.12.2013
Approved by M.Tarnowski 17.12.2013
Responsible department PPHV
Dimensional draw
Combined instrum
transformer
PVA 123a-145
ABB
ABB Sp. z o.o. Power Products

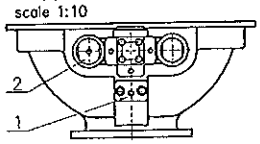


Oil level indicator
4 x ø 30
Lifting eye
Composite insulator
/Silikonisolator/
/Izolator kompozytowy/
Rating plate
Cable glands 2x M32 + 2x M40
also executions acc to order
Secondary terminal box
P1
P2/A
A
scale 1:10
P2/A
600 A
300 A
Primary termi
Flat terminals - Aluminium alloy
B
scale 1:3
DIN 46
Earthing terminals
C
scale 1:3
Mechanical load
Maximum operating voltage (kV) 145
Total weight (kg) 520
Insulating oil amount (kg) 150
Wind pressure surface (m²) 1,03
Creepage distance (mm) 4495

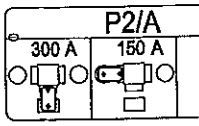


D
scale 1:4

A
scale 1:10



P2/A



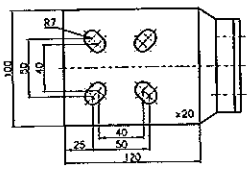
Primary termin

1 2

Flat terminals – Aluminium alloy

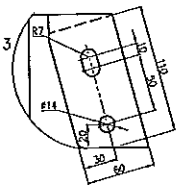
DIN 462

B
scale 1:3

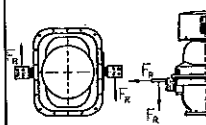


Earthing terminals

C
scale 1:3



Mechanical load



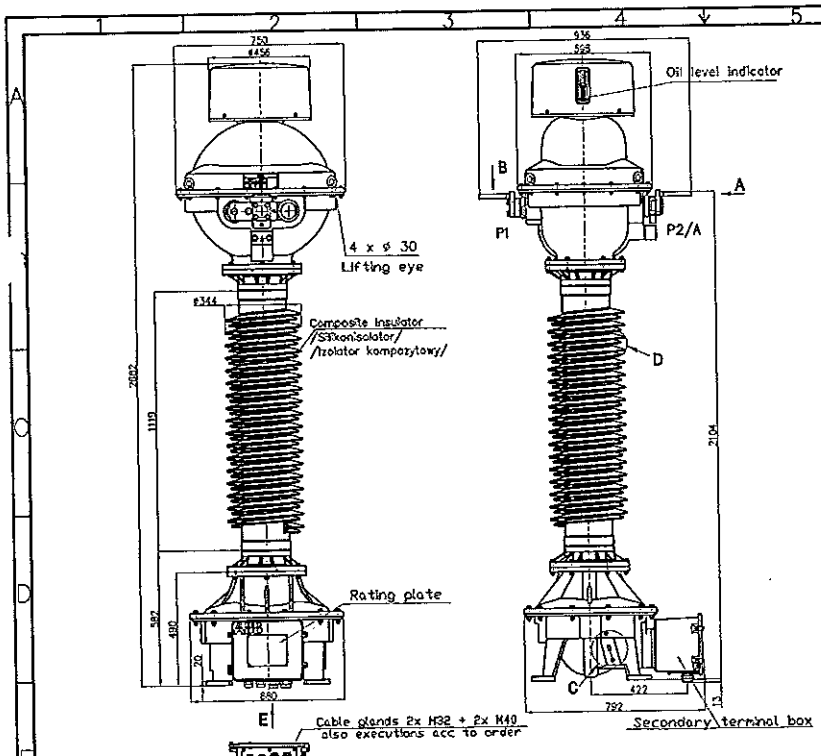
Maximum operating voltage	(kV)	145
Total weight	(kg)	540
Insulating oil amount	(kg)	150
Wind pressure surface	(m²)	1,03
Creepage distance	(mm)	4495
Mechanical load:		
F_R – Static load	(kN)	3,6
F_R – Dynamic load	(kN)	5,0

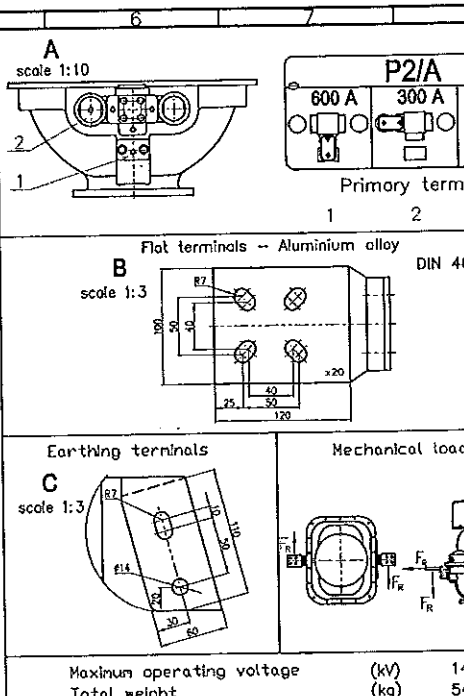
Standard IEC 61869-4

Prepared by P.Grysztar	Date 17.12.2013	Replacement of	Scale 1:
Verified by Z.Wesołowski	Date 17.12.2013	Responsible department PPHV	Title Dimensional drawin Combined instrume transformer PVA 123a–145a
Approved by M.Tarnawski	Date 17.12.2013	Take over department	
Revision A			

ABB ABB Sp. z o.o. Power Products

Document no. 2PXX614123/ABB PAD_TS_XU572/13





ABB

Combined Instrument Transformer

Type: PVA 145a

Insulation level	145/275/650kV	Standard	IEC 61869-4	fn	50 Hz
Oil type	Nytro Libra	Weight / Oil weight	520 / 150 kg	Temp. range	-40°C → +40°C
S/N	86142 / 13	Voltage factor	1,9Un/8h	Ue	0,2 mV/kA

CURRENT PART

K_n 150-300-600/5-5 A/A

$I_{th}/1s$ 40-40-40 kA I_{dyn} 100-100-100 kA

I_{cth} 180-360-720 A

	1S1-1S2	2S1-2S2	3S1-3S2	4S1-4S2	5S1-5S2	6S1-6S2
A	5	5				
VA	30	30				
Class	5P	5P				
FS/ALF	20	20				
Ext.%						

VOLTAGE PART

A-N 132:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	110:√3	110:√3			
VA	25	25			
Class	0,5	0,5/3P			
VA_{sn}	1000	1000			

Transportation: Vertical / Horizontal

ABB

Combined Instrument Transformer

Type: PVA 123a

Insulation level	126/230/550 kV	Standard	IEC 61869-4	fn	50 Hz
Oil type	Nytro Libra	Weight / Oil weight	540 / 150 kg	Temp. range	-50°C → +40°C
S/N	2GKP013K1486138	Voltage factor	1,9Un/8h	Ue	0,2 mV/kA

CURRENT PART

K_n 50-100-200 / 5-1-5-1-1 A/A

$I_{th}/1s$ 40 - 63 - 63 kA I_{dyn} 100 - 158 - 158 kA

I_{cth} 100 - 200 - 400 A

	A	VA	class	FS/ALF	Ext.%
1S1-1S2	5	1 -> 5	0,5	5	200
2S1-2S2	1	1 -> 2,5	0,5	10	200
3S1-3S2	5	10	5P	10	-
		2,5	5P	80	-
4S1-4S2	1	Rb=3,5Ω,class PX, 4-2-1/200, Ek=190 V, Ie<=0,1 A / 95 V, Rct<=0,3Ω, Kx=50			

VOLTAGE PART

A-N 110:√3 kV

	1a-1n	2a-2n	3a-3n	4a-4n	da-dn
V	100:√3	100:√3	100:√3	100:√3	100:3
VA	25	25	25	25	100
Klasa	0,1	0,1	0,1/3P	0,1/3P	1,0
VA	(25)	(25)	(500)	(25)	300)
Klasa	(3)	(3)	(3/3P)	(3/3P)	(3P)