International Nuclear Utilities Obsolescence Group

Guidance Document – Shareable Equivalency Evaluation

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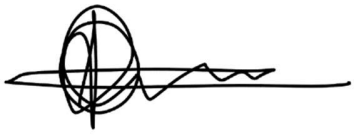
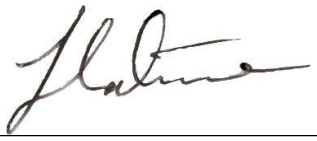
INUOG Product Approval

Arne Claes INUOG Vice Chairman		June 20, 2024
Preparer	Signature	Date
Atte Alander INUOG Advisor		June 23, 2024
Reviewer	Signature	Date

☒ Reviewer signs on behalf of the INUOG Steering Committee

John Latimer INUOG Chairman		June 26, 2024
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Guidance Document

Shareable Equivalency Evaluation

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1 Purpose of this document

The purpose of this guidance document is to introduce the shareable Equivalency Evaluation template and explain how it can be used by nuclear utilities and vendors to summarize a completed equivalency evaluation or to request help in search for an equivalent replacement item.

2 Introduction

In the industry of nuclear power generation, ensuring the safe and efficient operation of ageing facilities is paramount. As equipment ages and technology evolves, the industry faces challenges related to obsolescence—particularly when critical components become outdated or are no longer supported by manufacturers. To tackle this issue, the concept of equivalency evaluation is being implemented by many nuclear utilities worldwide to ensure efficient and proactive assessment of equivalent item replacements.

2.1 Concept of Equivalency Evaluation

Revision 1 of the Electrical Power Research Institute's (EPRI) report 1008256 '*Plant Support Engineering: Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants'* [1] was published in 2006 and provides guidelines for performing technical evaluations of replacement parts procured for nuclear power plants.

It introduces an equivalency evaluation as an approach for evaluating an alternate replacement item and determining whether it is equivalent to the original and, therefore, suitable for its intended application(s). The report introduces one approach where the design characteristics of the replacement item are compared with the design characteristics of the original item to determine if the replacement item is equivalent. Design characteristics are properties or attributes that are essential for the item's form, fit, and functional performance. These are identifiable and/or measurable attributes of a replacement item that provide assurance that the replacement item will perform its design function, as explained by EPRI [1].

2.2 Advantages of Equivalency Evaluation

A nuclear operators' design change- or engineering change process is typically a robust process put in place to evaluate modifications made to an existing nuclear plant or system in a multidisciplinary way. These alterations can be driven by safety enhancements, technological advancements, or operational improvements. The process provides a comprehensive analysis and demonstration to ensure that the proposed change does not compromise (nuclear) safety. Regulatory bodies closely oversee the process and its extensive documentation, safety assessments, and approvals.

In the nuclear industry, equivalency evaluations are often preferred over the design and engineering change process when assessing equivalent replacements. Here's why:

	Equivalency evaluation	Engineering Change Process
Efficiency	These evaluations ensure that critical design and operational characteristics remain intact. The standardized processes allow for quicker assessments.	These changes involve broader modifications to the system, which can introduce additional risks. They therefore involve more extensive documentation, multidisciplinary

		reviews and regulatory reviews which can be time-consuming.
Risk Minimization	Focus on specific components or parts. By minimizing changes, they reduce the risk of unintended consequences.	Larger-scale modifications may have broader implications, potentially affecting other system components.
Regulatory involvement	While this depends on national legislation, the national regulatory body is either not involved or performs a more graded review of the evaluation.	Requires comprehensive documentation and regulatory approvals, which can be resource intensive.
Operational Impact	Since the replacement typically doesn't affect system's form, fit and function, the operational impact is limited.	May disrupt existing operations and require adjustments to plant documentation, procedures, etc...

In summary, equivalency evaluations are an effective approach for assessing replacements without having to mobilize a lot of resources and competencies, making them a preferred tool in the nuclear industry for efficiently validating replacement items for obsolete components.

3 Industry initiatives

The nuclear industry has witnessed remarkable progress in recent years, driven by a concerted effort to improve and standardize equivalency evaluations. Stakeholders have collaborated on initiatives aimed at standardizing and enhancing the process. In this chapter, we explore some projects that have shaped nuclear equivalency evaluation, ensuring safety, reliability, and efficiency across the sector.

3.1 Standardized Item Equivalency Process

One of the most known and effective efforts is known as 'Delivering the Nuclear Promise'. This initiative was a multiyear strategy in the United States nuclear industry that aimed to transform the industry, enhance safety, and ensure long-term viability. Nuclear operators and institutes partnered to achieve substantial cost reductions through improved efficiency and increased reliability. As part of this initiative a project called 'Standardized Item Equivalency Process (SIEP)' was launched in 2017 to develop an industry-standard approach used in the nuclear field to evaluate alternate replacement items. The project has delivered:

- NISP-EN-02 - Standard Item Equivalency Process, R1
- NISP-EN-02 Forms (Short & long form standardized template)
- NISP-EN-02 Standard Item Equivalency Mentor Guide, R1
- NISP-EN-02 Standard Item Equivalency Mentor Guide Key, R1
- NISP-EN-04 Standard Digital Engineering Process, R2
- NISP-EN-04 Digital Engineering Mentoring Guide, IMG-ENG-002, Rev

The above-mentioned deliverables are available on the Design Oversight Working Group (DOWG) – Nuclear Community website hosted by the Institute of Nuclear Power Operations (INPO). You will need

to register first through https://community.nantel.org/login to get access to the DOWG Nuclear Community.

While the deliverables of this project have been implemented by several US nuclear utilities and vendors, they haven't been widely implemented by utilities outside of the United States and Canada.

3.2 International Nuclear Utilities Obsolescence Group

The International Nuclear Utility Obsolescence Group (INUOG) is an industry forum that facilitates collaboration among nuclear utilities worldwide. Its primary focus is on addressing obsolescence issues related to equipment and systems within the nuclear industry. INUOG aims to develop processes, tools, measures, and techniques to mitigate risks at the station level, ultimately supporting equipment reliability and availability.

Inspired by the 'Standardized Item Equivalency Process (SIEP)' the INUOG set the objective in 2018 to further promote the concept of 'Equivalency Evaluation' within the worldwide nuclear community. An INUOG Project was launched that at first aimed to develop an international guideline including best practices. Several working group meetings took place which had good attendance from utilities and vendors. Initially, the NISP-EN-02 Standard Item Equivalency Process document was analysed. From the start it appeared difficult to get a mutual understanding of the definitions and US regulations referred to in the document. A thorough survey performed among the working group members and international industry peers showed that differences in process maturity, approach, applicability, implementation and regulation with regards to the Equivalency Evaluation process were so big it was too challenging to get a common understanding from the start of the project.

It was clear that, on the international level, there is a language barrier which makes it complicated to come up with a common agreed terminology and understanding. Additionally, there is a vast existence of different national nuclear regulators and regulations which make harmonizing the Equivalency Process only possible to a certain extent. In 2023, the INUOG project changed direction and aimed to develop a Shareable Equivalency template and associated guidance document.

4 Shareable Equivalency Evaluation

Notably, the INUOG Equivalency Evaluation project shifted its focus in 2023 to create a Shareable Equivalency Evaluation template and an associated guidance document. It was obvious that worldwide, nuclear utilities that had implemented an equivalency process have developed tailormade processes to be compliant with national nuclear regulation. In some cases, the equivalency process is integrated in the engineering change process. In other cases, the process is implemented as a separate process. The extent of multidisciplinary or regulatory review varies among utilities worldwide. Definitions and terminologies used are also highly utility specific. At this stage, it therefore appears not reasonably feasible to try and harmonize the Equivalency process worldwide, in analogy with the US SIEP procedure.

Since the aim of INUOG is to collaborate and stimulate nuclear utilities to collaborate and share solutions, the project searched how it could generate the most benefit for utilities. Two important root causes have been identified that hindered utilities from openly sharing and collaborating together to solve equivalent replacements:

1) It appeared that utilities are often reluctant to share a complete Equivalency Evaluation. Engineering justifications, written to justify differences in form, fit and function of a replacement item compared to the original item, depend on the analysed application(s). It can well be that a

certain replacement item is equivalent for one plant application but isn't for another application. Since these engineering justifications are often a delicate part of the analysis, they prevent utilities from 'openly' sharing equivalency evaluations amongst each other.

2) Utilities searching for an equivalent replacement item typically ask for help based on the item manufacturer and manufacturer item number. In some cases, the manufacturer item number specified by the utility is only shared partially, lacking important suffixes to deduct the relevant design characteristics. This makes it difficult for other utilities and vendors to assess whether they have an equivalent available.

The INUOG community developed **the Shareable Equivalency template** to solve both above-mentioned issues, thereby having **a multi-purpose objective**:

- **summarize the high-level content of an equivalency evaluation without having to share the in-depth analysis and the plant application.**
- **Standardize the specified data of the original item in case of a request for help.**

In the first scenario, the summary can help other utilities find a potentially suitable replacement and gives them a first quick overview of the most significant differences of both items' design characteristics. Based on this limited information a utility should be able to assess relatively easily whether the replacement could also be a good 'fit' for their specific plant application. For more in-depth information utilities can contact each other to exchange operating experience. In the second scenario, the template helps the utility requesting for help in finding an equivalent replacement to specify sufficient information for other utilities or vendors to help their search. This standardization helps vendors to get insight more effectively in utility requests for help.

Examples of both cases can be found in Appendix II and III.

The content and data fields of the INUOG Shareable Equivalency template is inspired by the NISP-EN-02 'Short form standardized template' and was generated by withholding the most relevant data fields.

5 Instructions for completing the equivalency template

Every utility or vendor should be able to easily complete the Shareable Equivalency template (Appendix I) relatively fast and with low effort. Again, the objective of the template can be to give an executive summary of an equivalency evaluation that a utility or vendor has performed, not the in-depth analysis itself or to request help in finding a suitable replacement. This chapter clarifies the data fields that make up the template. The template contains three sections: general information, the equivalency evaluation and a conclusion/remarks section.

Important remark: In case the template is used to **request help** only the fields highlighted in grey shall be filled in. A utility or vendor can afterwards complete the remaining fields to suggest a potential replacement to the requesting utility.

Examples of both cases can be found in Appendix II and III.

5.1 Section 'General Information'

This section of the template aims to unambiguously identify the original item and the studied replacement item. The following fields can be found on the template:

Data field	Explanation
Manufacturer	Refers to the company or entity involved in producing the item. Note that the manufacturer can be different from the item supplier or distributor. The latter two are often area- or region specific and therefore not relevant.
Manufacturer Item number	Refers to a unique identifier issued by the item manufacturer to distinguish individual products. It typically consists of a series of numbers and letters. Note that suppliers or distributors sometimes also add a unique identifier, but these are not relevant.
Product series/family/model	A product series or product family refers to a group of related items produced by a manufacturer. These items share common features, design elements, and specifications.
Component type	A component type or family refers to a group of related components or equipment used within nuclear facilities that share common features, design elements, and specifications. For example, valves, pumps, relays, breakers, motors.
Analyzed by	Name of the nuclear utility or vendor that has performed the evaluation.
Equivalency report reference	The internal reference number for the equivalency evaluation conducted by a utility or vendor allows other utilities to seek more detailed information from the entity that performed the evaluation. It serves as a unique identifier for tracking and communication purposes.
Intended (safety) function	Refers to the specific purpose or role of an item in a host component or system within a nuclear facility. In some cases, it could be useful to also describe the function of the host component.
Parent component is	This checkbox data field gives the possibility to indicate the applicable requirements e.g., EQ, ASME, …
Photo/nameplate	Photo of the original and studied replacement item (if reasonably feasible). In some case the item nameplate could be more relevant.

5.2 Section ‘Equivalency’

In this section the most important or relevant design characteristics are compared between the original and replacement item. The objective is not to list all assessed design characteristics, but to highlight those that provide the most confidence to demonstrate that both items are equivalent. If one or more design characteristic is different and could potentially be considered as being not equivalent it is important to highlight this information in the ‘comparison’ column. Even when there are differences between the original and replacement item, some utilities might still be able to accept these differences through their equivalency process given some compensatory measures are taken.

The following table gives more information on how to interpret the column ‘comparison’.

Comparison value	**Explanation**
‘Identical’	when the studied design characteristic of the replacement item has exactly the same value as the original item. *E.g., The nominal voltage of both items is 220Vac.*
‘Equivalent’	when the studied design characteristic of the replacement item has a different value than the original item but is still considered equivalent by the analysing entity for the studied application. It is up to the reader to decide whether this difference could be accepted as equivalent given the specific bounded technical requirements of the application for which the replacement item is evaluated. *E.g., The weight of the replacement is lower than the original item and therefore different. However, for the studied application the lower mass has a beneficial impact on the seismic mounting and is considered equivalent*.
‘Different’	when the studied design characteristic of the replacement item has a different value than the original item, which is not considered equivalent by the analysing entity for the studied application. *E.g., The original item was screw-mounted while the new item can only be installed mounted on a DIN-rail.*

It is up to the author to determine how many design characteristics to list and discuss.

5.3 Section ‘Conclusion/remarks’

This section provides the overall conclusion of the equivalency evaluation. It can be used to detail some of the differences between the original and replacement item, list some special points of attention and links to non-proprietary manufacturer documents.

Special Points of Attention:

- Maintenance Prescriptions: Specific maintenance procedures or intervals may be necessary to ensure continued functionality. Refer to any prescribed maintenance guidelines.
- Storage Instructions: Proper storage conditions are crucial. Refer to recommended storage temperatures, humidity levels, and handling precautions.

Links to Non-Proprietary Manufacturer Documents: To give the reader more detailed information, the author can refer to publicly available manufacturer documents. These documents provide insights into design specifications, operating instructions, and safety considerations.

6 References

Ref	Document
[1]	Plant Support Engineering: Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants—Revision 1. EPRI, Palo Alto, CA: 2006. 1008256.
[2]	INUOG-2024/002: Shareable Equivalency Evaluation template

7 Justification for Modification

Version Number	Reason for modification	Changed pages
00	New document	ALL

Appendix

Appendix I: Shareable Equivalency Evaluation Template

EQUIVALENCY EVALUATION
Executive Summary

International Nuclear Utilities Obsolescence Group

Template Ref.: INUOG-2024/002 | Rev. 00

A. General Information

	ORIGINAL ITEM	REPLACEMENT ITEM
MANUFACTURER		
MANUFACTURER ITEM NUMBER		
PRODUCT SERIE / FAMILY/MODEL		
COMPONENT TYPE		
REQUESTED/ANALYZED BY (Name utility/supplier)		
EQUIVALENCY REPORT REFERENCE		
INTENDED (SAFETY) FUNCTION		

PARENT COMPONENT IS:

☐ EQ ☐ ASME SECTION III ☐ SEISMIC CLASS I
☐ CLASS 1E ☐ CONTAINMENT PRESSURE BOUNDARY ☐ OTHER _____

PHOTO ORIGINAL / NAMEPLATE	PHOTO REPLACEMENT / NAMEPLATE

B. Equivalency

Identify the design characteristic(s) of the replacement item that are different from the original (installed) item. Attach additional pages as necessary.

Design Characteristic	Original	Replacement	Comparison
			Choose an item.
			Choose an item.
			Choose an item.
			Choose an item.
			Choose an item.
			Choose an item.

C. Conclusion/remarks

Short summary of the evaluation. Special points of attention (e.g., special maintenance prescriptions or storage instructions, …). Links to non-proprietary manufacturer documents.

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Request for help: fill in grey fields only

Appendix II: Example – Use case 'Summary'

EQUIVALENCY EVALUATION
Executive Summary

International Nuclear Utilities Obsolescence Group

Template Ref.: INUOG-2024/002 | Rev. 00

A. General Information

	ORIGINAL ITEM	REPLACEMENT ITEM
MANUFACTURER	Phoenix Contact	Weidmüller
MANUFACTURER ITEM NUMBER	0205038	0303560000
PRODUCT SERIE / FAMILY/MODEL	SSK135KRI	SAK35
COMPONENT TYPE	Terminal block	
REQUESTED/ANALYZED BY (Name utility/supplier)	ENGIE Electrabel	ENGIE Electrabel
EQUIVALENCY REPORT REFERENCE	10011148132	
INTENDED (SAFETY) FUNCTION	Carry current between terminals & provide isolation.	

PARENT COMPONENT IS:

☒ EQ ☐ ASME SECTION III ☐ SEISMIC CLASS I

☒ CLASS 1E ☐ CONTAINMENT PRESSURE BOUNDARY ☐ OTHER: _____

PHOTO ORIGINAL / NAMEPLATE	PHOTO REPLACEMENT / NAMEPLATE
	

B. Equivalency

Identify the design characteristic(s) of the replacement item that are different from the original (installed) item. Attach additional pages as necessary.

Design Characteristic	Original	Replacement	Comparison
Rated current	135 A	125 A (max 150 A)	Equivalent
Rated voltage	750 V	800 V	Equivalent
Weight	76.1 g	52.6 g	Different
Isolator material	Melmine (Kri)	Polyamide (PA66)	Different
Operating environment	Not specified	-50 to 100 °C	/
Type of mounting	Clamped for T32 rail	Clamped for T32 rail	Identical
Connection type	Screw connection	Screw connection	Identical
# clamping points	2	2	Identical
Dimensions (DxHxW)	67 x 53 x 15,2 mm	67,5 x 58 x 18 mm	Equivalent
Wire cross section	2,5 – 25 mm^2	2,5 – 50 mm^2	Equivalent

C. Conclusion/remarks

Short summary of the evaluation. Special points of attention (e.g., special maintenance prescriptions or storage instructions, …). Links to non-proprietary manufacturer documents.

The replacement feed-trough terminal block is considered equivalent. Replacement material shall need to be accepted from an EQ point of view by the site. The width of the new terminals blocks is slightly bigger, check if sufficient space available on currently installed DIN rail. Apply Weidmuller's specified tightening torque.

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Request for help: fill in grey fields only

Appendix III: Example – Use case 'Request help'

EQUIVALENCY EVALUATION
Executive Summary

International Nuclear Utilities Obsolescence Group

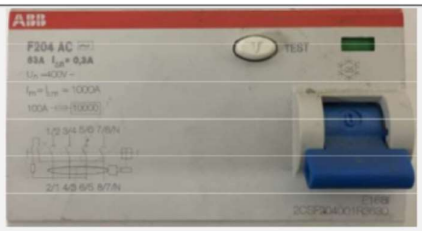
Template Ref.: INUOG-2024/002 | Rev. 00

A. General Information

	ORIGINAL ITEM	REPLACEMENT ITEM
MANUFACTURER	ABB	
MANUFACTURER ITEM NUMBER	2CSF204901R3630	
PRODUCT SERIE / FAMILY/MODEL	F204 AC S-63/0,3	
COMPONENT TYPE	Residual Current Circuit Breaker	
REQUESTED/ANALYZED BY (Name utility/supplier)	Utility A	
EQUIVALENCY REPORT REFERENCE		
INTENDED (SAFETY) FUNCTION	Assures protection to people and installations against fault current to earth.	

PARENT COMPONENT IS:

☐ EQ	☐ ASME SECTION III	☐ SEISMIC CLASS I
☐ CLASS 1E	☐ CONTAINMENT PRESSURE BOUNDARY	☒ OTHER: non-1E

PHOTO ORIGINAL / NAMEPLATE	PHOTO REPLACEMENT / NAMEPLATE
	

B. Equivalency

Identify the design characteristic(s) of the replacement item that are different from the original (installed) item. Attach additional pages as necessary.

Design Characteristic	Original	Replacement	Comparison
# poles / aux. contacts	4 / -		Choose an item.
Rated voltage	400V – 50/60 Hz		Choose an item.
Rated current / residual current	63 A / 300 mA		Choose an item.
Type of Residual Current	AC (IEC-61008)		Choose an item.
Rated Short-Circuit Current (Inc)	10 kA		Choose an item.
Connection type	Screw, up to 25 mm2		Choose an item.
Mounting type	Rail DIN 35 mm		Choose an item.
Dimensions (Height, Width, Depth)*	85 x 70 x 69 mm		Choose an item.
Weight (without accessories)	0,375 kg		Choose an item.

C. Conclusion/remarks

Short summary of the evaluation. Special points of attention (e.g., special maintenance prescriptions or storage instructions, …). Links to non-proprietary manufacturer documents.

* Equivalent replacement item would ideally be of same width due to limited space in cabinet. A larger height and depth can be accepted.

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Request for help: fill in grey fields only

CONTRIBUTORS TO DRAFTING AND REVIEW

In the process of creating any substantial work, there are individuals who play pivotal roles in shaping its content. This chapter focuses on acknowledging and honouring those contributors. Whether they participated in the initial drafting or provided critical feedback during the review phase, their impact is invaluable. This chapter serves as a tribute to the collaborative spirit that drives meaningful work forward.

ÅLANDER, Atte	TVO
ARCHILLA MARTIN-SANZ, Jacobo	Iberdrola
BEENE, JOSEPH	Framatome
CALLENBERG, Niclas	Vattenfall - Ringhals
CARDENAS, Nicolas	Eskom
CASTRO, Nicolas	ORANO
CLAES, Arne	ENGIE Electrabel
CLANCEY, Christina	Westinghouse
EGGENBERGER, Patrik	Westinghouse
GAVIN, Paul	Urenco
HARBOM, Mathias	Forsmarks Kraftgrupp AB
JACQUOT, Frederic	Westinghouse
JOHN, Chris	EDF
MUÑOS TIRADO, Juan Antonio	Nucleonova S.L.
LINDER, Johan	Vattenfall - Ringhals
LATIMER, John	EDF Energy
LUGAR, Robert	Bruce Power
PERES, Jean-Christophe	Framatome
PERSSON, Magnus	Forsmarks Kraftgrupp AB
PORTER, Keith	Paragon
ROSE, Adam	Element Nuclear
SALTO, Jordi	ANAV
SPARF, Anders	Vattenfall - Ringhals
TANNENBAUM, Marc	EPRI

Working group sessions

Virtual	: 24 March, 21 April, 10 May 2023 – *Brainstorm Session*
Paris, France	: 22-23 May 2023 – *INUOG Annual meeting, break-out session*
Virtual	: 29 June 2023 – *INUOG Monthly technical meeting, review session*
Brussels, Belgium	: 27-29 May 2024 – *INUOG Annual meeting, break-out session*