

SIL versus dedication in EPRI 3002002982¹

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1. Introduction

Dedication² is defined in as;

An acceptance process that is undertaken to provide “reasonable assurance ” that a commercial-grade item to be used as a basic component will perform its intended safety function and, in this respect, is deemed equivalent to an item designed and manufactured under a 10CFR50, Appendix B QA program(10CFR21).

SIL is defined as;

“Safety integrity level (SIL) is defined as the relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction. In simple terms, SIL is a measurement of performance required for a safety instrumented function (SIF). ”

The International Electrotechnical Commission (IEC) standard [61508](#)[1] defines SIL using requirements grouped into two broad categories: hardware safety integrity and systematic safety integrity. A device or system must meet the requirements for both categories to achieve a given SIL. This will present the summary of EPRI 3002002982[2] and the different perspectives between SIL certification and dedication.

2. EPRI 3002002982 hierarchy

EPRI 3002002982 has been supplemented by series of documents in order to provide the guides in dedicating commercial grade digital devices as indicated in Figure 1.

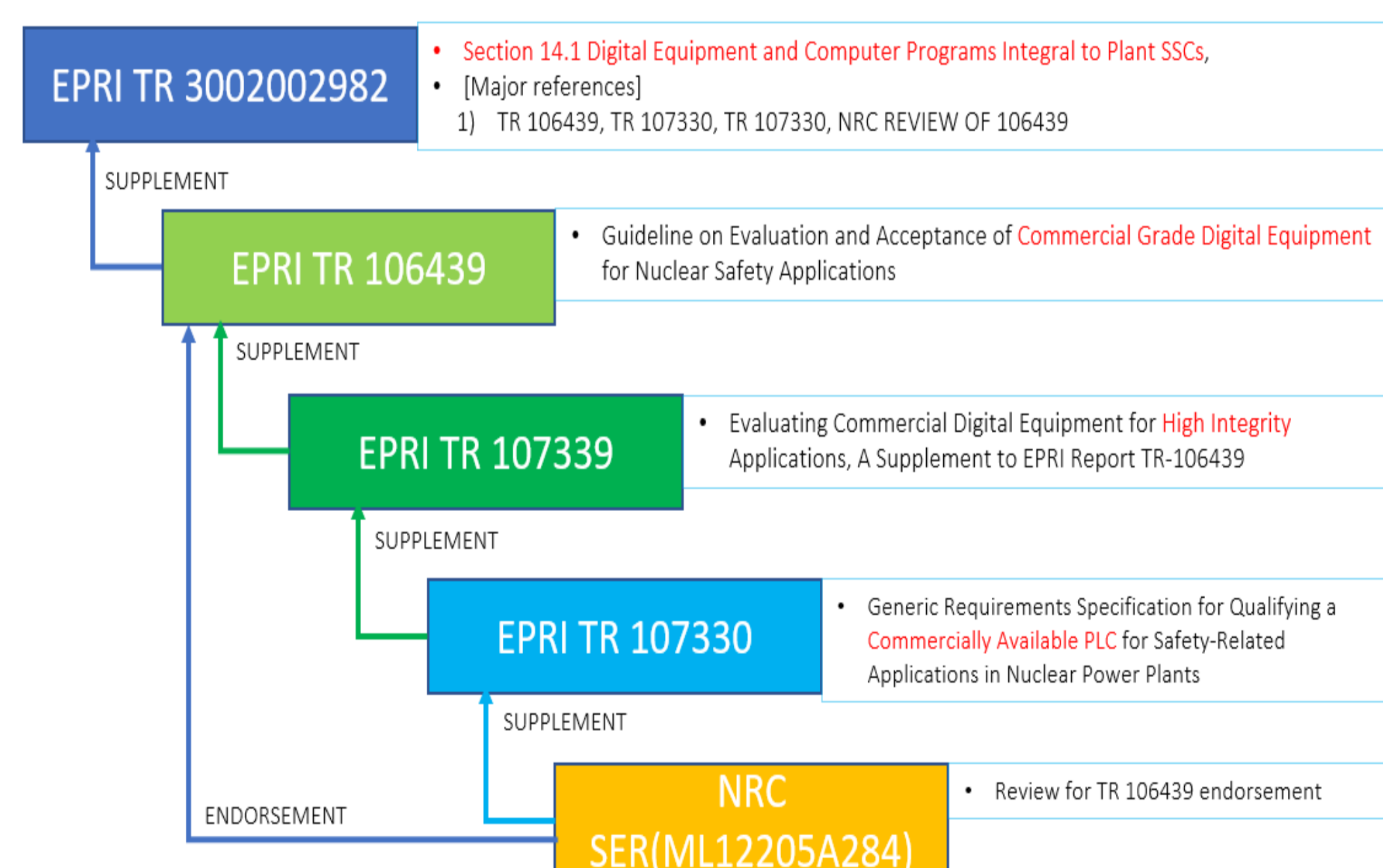


Figure 1 Hierarchy of EPRI 3002002982's supplements

EPRI 3002002982, and its supplements EPRI TR-106439

Dedication is conceptually used interchangeably with qualification, justification, suitability and selection and use.

3. Topic summary of EPRI 3002002982

EPRI 3002002982 provides detailed methodology, as briefly shown in Figure 2, and examples for dedication, and details related to digital devices are provided in supplement of EPRI TR-106439[3].

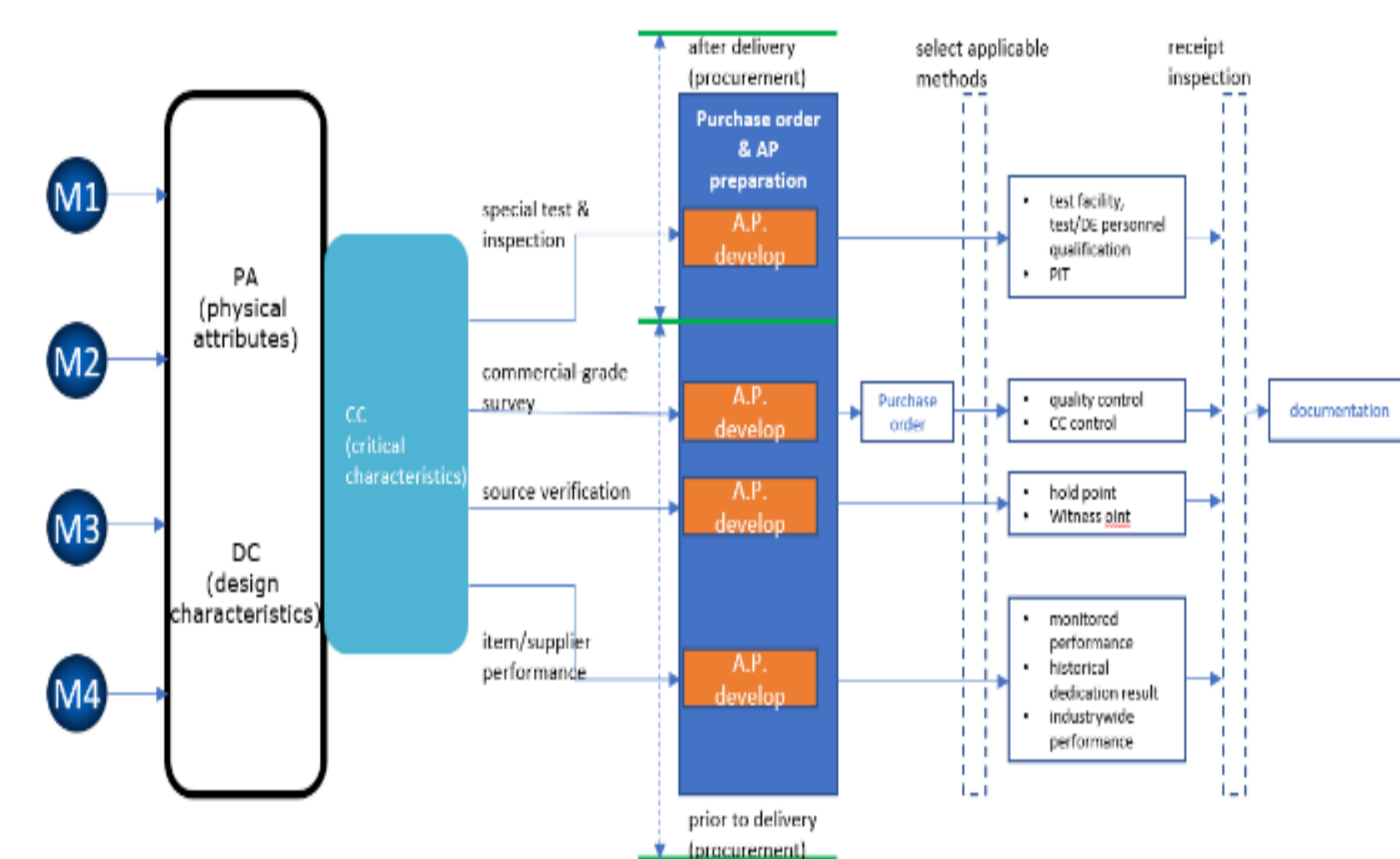


Figure 2 Process for Methods implementation

A summary of the main topics is as follows:

Topic-1: DC vs. CC

Although the selection of Critical Characteristics (CC) and Technical Evaluation (TE) are emphasized, it should not be overlooked that Design Characteristics (DC) other than CC should justify that they do not adversely impact CC. In particular, it becomes a more important issue in the case of technologies such as smart devices (software) and AI technologies, where complexity increases.

Topic-2: Completeness of Purchase Specification

Out of the entire project process, the execution time of Method-1 to 4 shows the characteristics of preceding, paralleling, or succeeding, so it is absolutely necessary to prepare the utility purchase order perfectly.

Topic-3: Post-Installation Test (PIT)

According to EPRI 3002002982, the execution of TE and AP is important, but the PIT completion execution and dedication maintenance are more emphasized.

Looking at the important difference between certifications such as Commercial Grade Item dedication (CGD) and SIL, in other words, SIL can help with the pre-purchase of identical spare parts, but must also be accompanied by actions for field application equivalent

to installation, operation, and maintenance to ensuring the plant level safety, which is pointed in classical verification and validation of software.

Topic-4: Maintenance of dedication

In the case of commercial grade survey, the maintenance period is recommended every 3 years before environmental changes occur. However, the maintenance for the remaining M-2~4 is not specified, so engineering judgment by Dedicating Entity (DE) may be required.

Topic-5: Qualifications of DE

Looking at the domestic situation, DE for the dedication is important to build experimental equipment such as facility holding institution, design experience institution in addition to technical review.

This guideline needs to be subdivided, and it is necessary to distinguish between technical review by expert groups and actual equipment qualification by large institutions holding test facilities, and through this, there is a need to diversify the dedication market.

Topic-6 Reportability in 10CFR21

Currently, it has not been confirmed whether the anomaly reporting system for products is being operated officially. However, since the use of nuclear energy for general commercial products is important due to the nature of the dedication, reporting and feedback of operating history and anomaly occurring during operation are very important factors. Therefore, it will be necessary to design a database schema based on this for building an element database rather than file data, build a system, and continuously operate it.

Topic-7: Smart devices

Especially for smart devices and AI learning models, it is necessary to supplement and refine the dedication methodology, and it seems necessary to configure the dedication methodology by referring to other documents such as IEC and IAEA in addition to EPRI documents.

4. PIT in EPRI 3002002982

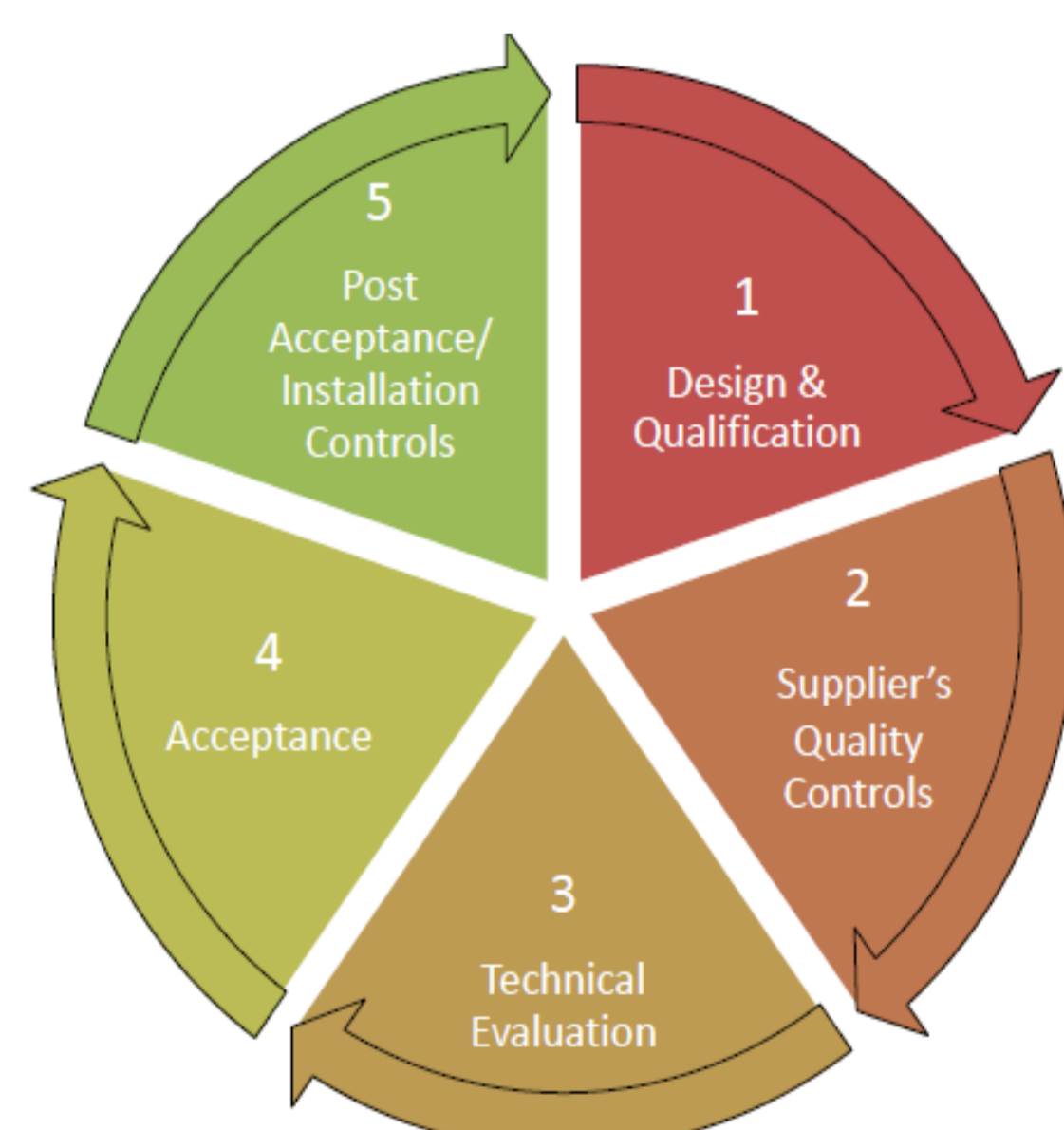


Figure 3 Elements ensuring the overall quality of plant equipment[3]

As mentioned earlier, certificates such as SIL are certifications for products, but dedication pursues

dependability of the entire power plant level safety considering product application, operation, and maintenance(See Table 1). Therefore, although DC, CC selection and TE are important technical information, the activities of 5(post acceptance/installation control) in Figure 3 should be additionally considered.

Table 1 Perspectives from SIL and dedication

Item	SIL	Dedication
Focus	Products	Plant level safety
Identity	Certification Organization	Qualified engineer
Life-cycle	Sell and delivery	Plant operation
Test	Functionality	Field adaptation

5. Conclusions

Through this contribution, the difference between CGD and SIL should be highlighted once again, and corresponding dedication including verification and validation activities should be made.

Based on the technical activities corresponding to 5 of the dedication activities, it is clear that the certificate can be used as an input for the dedication but cannot replace the dedication especially focusing on field applicability and plant level integrity of intended safety function.

Some smart digital devices, AI learning models, and other IoT products now usually have high COMPLEXITY, and design-based regulation may be required in deterministic regulation, so preliminary research seems necessary.

It is recommended that model for Qualitatively Quantitative Dedication(QQD) for smart digital devices dedication be established for ensuring systematic dependability building in future. For example, Moore's industry is experimenting to build 2-leg approach for reasonable assurance for commercial to meet IEC 61508 requirement and attempting to apply in nuclear sector too.

REFERENCES

- [1] IEC 61508, Functional Safety in Industrial Manufacturing Functional safety of electrical/electronic/programmable electronic safety -related systems series
- [2] EPRI 3002002982, "Plant Engineering: Guideline for the Acceptance of Commercial-Grade Items in Nuclear Safety-Related Applications, Revision 1 to EPRI NP-5652 and TR-102260", 2014
- [3] EPRI TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications", 1996

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