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RISK-INFORMED INSERVICE INSPECTION (RI-ISI) DECISION TEMPLATE

TE-114543

EPRI NDE Center

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ABSTRACT

The US Nuclear Regulatory Commission through its PRA Policy Statement is encouraging the use of probabilistic risk assessment (PRA) technology. Blending the use of PRA with other deterministic insights and a defense in depth philosophy has been termed 'risk-informed'. The USNRC has developed regulatory guides and standard review plans for risk-informed applications.

EPRI TR-112657 "Revised Risk-Informed Inservice Inspection Evaluation Procedure" has been approved for use in developing risk-informed inservice inspection (RI-ISI) programs. TR-112657 provides the technical basis as well as process for conducting a RI-ISI evaluation. This report does not however provide guidance to a utility in deciding to what scope the RI-ISI should be applied, to what extent the RI-ISI effort should be integrated with other augmented inspection programs and in what timeframe should the RI-ISI be implemented.

This template provides a first step in supporting the utility thought process for identifying the scope, integration and timing of a RI-ISI application.

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RISK-INFORMED INSERVICE INSPECTION (RI-ISI) DECISION TEMPLATE

1.0 INTRODUCTION

The US Nuclear Regulatory Commission has approved for generic use EPRI TR-112657 "Revised Risk-Informed Inservice Inspection Evaluation Procedure" (Reference 1). TR-112657 provides the technical basis as well as process for conducting a risk-informed inservice inspection (RI-ISI) evaluation. This report does not however provide guidance to a utility in deciding to what scope the RI-ISI should be applied, to what extent the RI-ISI effort should be integrated with other augmented inspection programs and in what timeframe should the RI-ISI be implemented.

This template provides a first step in supporting the utility thought process for identifying the scope, integration and timing of a RI-ISI application.

2.0 PROCESS OVERVIEW

This section describes the RI-ISI process from an administrative and licensing perspective. The RI-ISI evaluation process is summarized in Figure 2-1 and explained in detail in TR-112657.

The administrative and licensing process that a utility would need to go through to implement a RI-ISI program is summarized in Figure 2-2 and is described in the following paragraphs.

The first step in the process is to define the scope of the RI-ISI application. Although this step appears to be straightforward, it is a critical step in the RI-ISI process and is discussed in additional detail in Section 3.

Once the scope of the application is defined, the RI-ISI evaluations for the in-scope piping are conducted (step 2). The RI-ISI evaluations include:

- risk significance determination,
- defining the number of required RI-ISI inspections,
- identification of the locations that will be inspected
- identification of inspection techniques

TR-112657 provides the technical and process details on how these evaluations are conducted.

Upon completion of the RI-ISI evaluations, a RI-ISI submittal (Step 3) must be made to the NRC for their review and approval (Step 4). Until the RI-ISI code cases are approved for use via Regulatory Guide 1.147 (Reference 2), the submittal process will use what is called a "Template Submittal". This template submittal was developed in conjunction with NEI and NRC to streamline the RI-ISI approval process. The template submittal

provides a summary level document referencing TR-112657 which is to be used by the NRC for their review and approval (i.e. granting an SER on the application).

Either in parallel or shortly after NRC approval, the existing ISI program will need to be revised to reflect the results of the RI-ISI effort (Step 5). This will consist of removing locations that were previously inspected via the old program, adding locations defined by the RI-ISI effort and updating NDE procedures, as appropriate, to reflect the RI-ISI locations.

The final two tasks consist of conducting the actual RI-ISI examinations (Step 6) and maintaining the RI-ISI program as a living document (step 7). There is work underway to generically define RI-ISI maintenance requirements. It is expected that these requirements will be generally consistent with existing Section XI maintenance and monitoring activities. This is true, as in order to impact the EPRI RI-ISI results; a significant plant change will be required.

3.0 DECISION CRITERIA

This section provides a discussion on those issues pertinent to making a decision relative to implementing a RI-ISI program. The major issues related to developing a RI-ISI program are:

- Scope of the application,
- Integration of augmented inspection programs,
- Timing of RI-ISI submittal and implementation,
- Maintenance costs,
- Integration with other plant activities, and
- Cost-benefit.

Scope of the RI-ISI Application

Initially RI-ISI applications were geared towards replacing ASME Section XI inspection programs in their entirety (i.e. Class 1, 2 and 3 piping) as well as requiring the incorporation of non-code class piping (e.g. non-nuclear safety; NNS or balance of plant; BOP piping). EPRI petitioned the NRC to allow partial scope applications because a number of plants would not pursue RI-ISI applications due to the increase cost of incorporating Class 3 and BOP piping without a significant increase in plant safety. With issuance of the safety evaluation report (SER) on the EPRI topical report, the NRC generically approved the use of RI-ISI for partial scope applications.

Specifically, utilities may implement RI-ISI on the following scopes:

- a single class of piping (e.g. Class 1 only),
- multiple classes of piping (e.g. Class 1 and 2),
- a single system (e.g. Reactor Coolant system), and
- multiple systems (e.g. Reactor Coolant and Residual Heat Removal systems).

Experience has shown that existing inspection program burden is not uniformly distributed across all classes of piping. That is, Class 1 piping has a disproportionately larger share of inspection burden as well as worker exposures. Class 2 has less than Class 1 and Class 3/NNS piping is significantly less than either Class 1 or 2.

Separate from inspection burden, there may be reasons for a utility to conduct RI-ISI evaluations on Class 3 and NNS/BOP piping. Although not important from a core damage or containment performance perspective, the integrity management function of these systems may be important for system and plant reliability reasons. As such, a utility may wish to incorporate these systems (or portion of systems) into the RI-ISI program. In addition, as these system tend to be predominantly effected by only the localized corrosion mechanism (e.g. MIC), utilities may wish to implement only a portion of the RI-ISI methodology to these systems. That is, conduct the failure potential evaluation focusing on localized corrosion and cavitation and do not conduct the remaining steps of the RI-ISI methodology (e.g. consequence evaluation, risk ranking).

Augmented Inspection Programs

ERPI TR-112657 allows for the incorporation of a number of augmented programs into the RI-ISI programs. This integration eliminates duplication between the existing Section XI program and other augmented programs which are either implemented in response to NRC mandates or plant specific issues.

Table 3-1 provides a listing of augmented programs, which are currently included in TR-112657.

There are two other significant augmented programs in which EPRI is conducting additional work. These are:

- Break exclusion requirements (BER), or high energy line break (HELB) piping, and
- Generic Letter 88-01, Category B-G weldments.

BER programs are very plant specific programs. That is, some plants have very few inspections associated with BER programs while for a number of plants the BER examinations for some piping is equivalent to the number of Section XI examinations conducted.

EPRI BWRVIP has commissioned a focus group to develop the technical basis to support a revision to NUREG-0313, Rev 2. This revision is addressing IGSCC categories B through G weldments. In requesting generic approval of EPRI TR-112657 it was decided to seek approval of only category A directly into the RI-ISI program. That is, IGSCC inspections are no longer required for category A weldments unless the RI-ISI identifies the need for inspection. For categories B through G weldments, the existing augmented examinations may be credited (up to 50%) in meeting the inspection requirements of the RI-ISI program, but may not be eliminated at this time.

Timing of RI-ISI Submittal and Implementation

The timing of a RI-ISI application can be impacted by three issues. That is,

- calendar time to conduct a RI-ISI evaluation,
- NRC review and approval of the RI-ISI program, and
- implementation of the RI-ISI program.

Utilities should plan on six to eight calendar months to conduct a Class 1 application. Full scope applications should be planned to require twelve to fifteen calendar months. A Class 1 and 2 application (or similar scope) should be somewhere in between these two extremes.

Factors that drive these estimates include whether the project will be conducted turnkey by outside staff, internally or some combination. Also, dedicated staff and an assigned high priority will support tighter schedules while a lower priority will certainly lengthen the schedule and may also impact cost efficiencies.

NRC has stated in public meetings that they expect to turn around template submittals in a timely fashion (i.e. 1 – 3 months). For planning purposes many utilities are assuming a six-month review cycle.

The EPRI RI-ISI methodology has been developed so that it is readily implementable into the existing Section XI inspection scheme. That is, inspection percentages are spread out over the ten-year inspection interval. As an example, if the RI-ISI program requires 100 inspections, they are spread out over the three inspection periods in accordance with the requirements of Section XI for minimum and maximum inspections.

There may be instances where an application is submitted and approved for use during the ten-year interval as opposed to at the beginning of the ten-year interval (e.g. after completion of the first inspection period). In these situations, the RI-ISI program would start at the beginning of the next inspection period (i.e. second inspection period) and two thirds of the required RI-ISI inspections would be conducted in the remaining two periods. For those cases where the RI-ISI program is approved in the middle of an inspection period, the utility will have to assure that code minimum/maximum inspection percentages are met.

The NRC has issued Information Notice 98-044 (Reference 3) which allows for utilities to have a two-year delay in implementing the piping portion of their next ten-year interval if they are pursuing a RI-ISI application.

Some utilities have used this information notice to support a relief request asking for a mid-interval delay.

With respect to implementation, once approved, RI-ISI implementation can begin immediately. One issue to consider in this implementation stage is the impact of IGSCC (category B-G) and BER/HELB inspections. Utilities may wish to conduct the RI-ISI evaluations incorporating these programs but only asking for approval consistent with TR-112657. Then, once these other programs have been approved generically by the NRC, the results can be fully implemented. This tack allows the utility to conduct the RI-ISI analyses only once.

Another implementation consideration is that of Class 3 and NNS piping. This scope of piping currently does not have any Section XI NDE requirements. As such, utilities wishing to implement RI-ISI on this scope could conduct the evaluations internally (as good practice) and not have to submit to NRC for their review and approval. In addition, utilities could then implement the RI-ISI program (for this scope) at any internally developed schedule.

Maintenance costs

In using the EPRI RI-ISI methodology, the costs associated with maintaining the program are not high and are generally consistent with existing Section XI maintenance requirements. This is what is known as a 'living program requirement'. EPRI will be developing guidance is how this should be done in 2000. It is expected that only significant plant changes (e.g. piping reroute) will impact the RI-ISI results. Other changes to the plant such as, a valve operator change due to Generic Letter 89-10 (MOV) concerns which impacted the piping stress analysis, will not need to be monitored nor fed back into the RI-ISI evaluations.

Integration with other plant initiatives

The RI-ISI program has the potential to significantly reduce plant burden (i.e. inspection costs, worker exposure and outage impact) while maintaining or increasing plant reliability. There are other 'soft issues' where RI-ISI can have a significant role. As an example, risk-informed applications are receiving positive attention at high levels within the NRC and other code/regulatory bodies. RI-ISI can also be one piece in a utilities' integrated risk management program.

Cost-Benefit

RI-ISI programs have been conducted for each of the NSSS designs. In addition, both partial and fullscope applications have been approved and implemented. Table 3-2 provides a listing of the inspection savings of the Class 1 plants completed to date. Table 3-3 provides a breakdown for the ANO-2 fullscope application. As can be seen from these tables, reduction in the number of inspections by 70% and worker exposure by up to 90% has been achieved.

The dollar cost savings associated with these results will be plant specific. The cost of conducting an inspection can range from as low as $2,000 to as high as $10,000 per inspection (not including ALARA penalties). Parameters that impact this range in cost include accessibility, scaffolding, insulation removal and re-installation, shielding requirements, HP support, Operations support, outage management, and contracted services.

The cost associated with developing a RI-ISI program will also be plant specific. The costs may range from as low as $100K for a Class1 effort conducted internally to $500-700K for a turnkey full-scope application.

4.0 SUMMARY

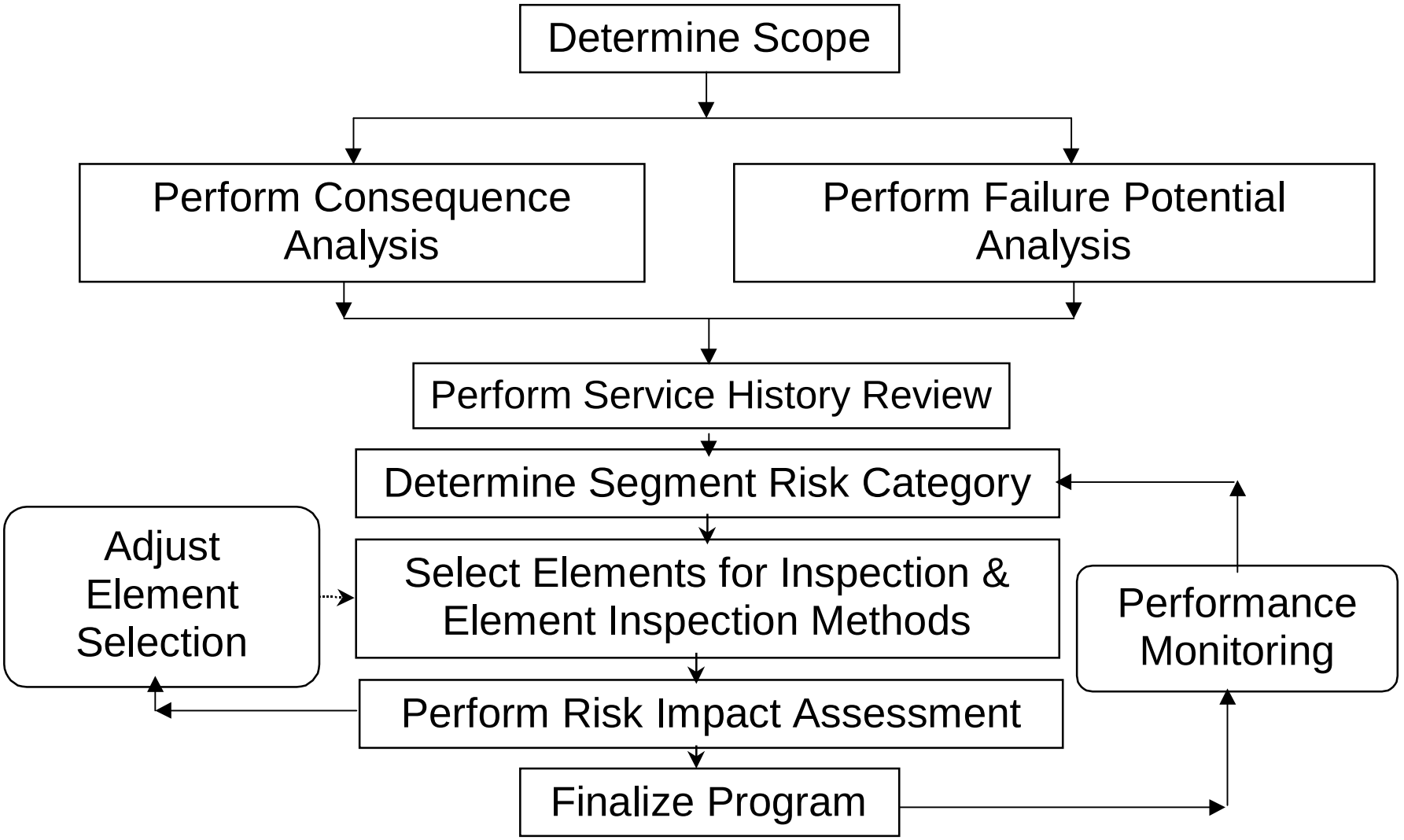
TR-112657 provides the technical basis as well as process for conducting a risk-informed inservice inspection (RI-ISI) evaluation. TR-112657 has been approved by the USNRC for generic use by utilities wishing to implement a RI-ISI program.

TR-112657 does not however provide guidance to a utility in deciding to what scope the RI-ISI should be applied, to what extent the RI-ISI effort should be integrated with other augmented inspection programs and in what timeframe should the RI-ISI be implemented.

This template provides a first step in supporting the utility thought process for identifying the scope, integration and timing of a RI-ISI application.

5.0 REFERENCES

1. EPRI TR 112657, Revised Risk-Informed Inservice Inspection Evaluation Procedure, October 28, 1999.
2. Regulatory Guide 1.147, Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1.
3. NRC Information Notice 98-44, Ten-Year Inservice Inspection (ISI) Program Update for Licensees That Intend to Implement Risk-Informed ISI of Piping, December 10, 1998.


Determine Scope
Perform Consequence Analysis
Perform Failure Potential Analysis
Perform Service History Review
Determine Segment Risk Category
Adjust Element Selection
Select Elements for Inspection & Element Inspection Methods
Performance Monitoring
Perform Risk Impact Assessment
Finalize Program

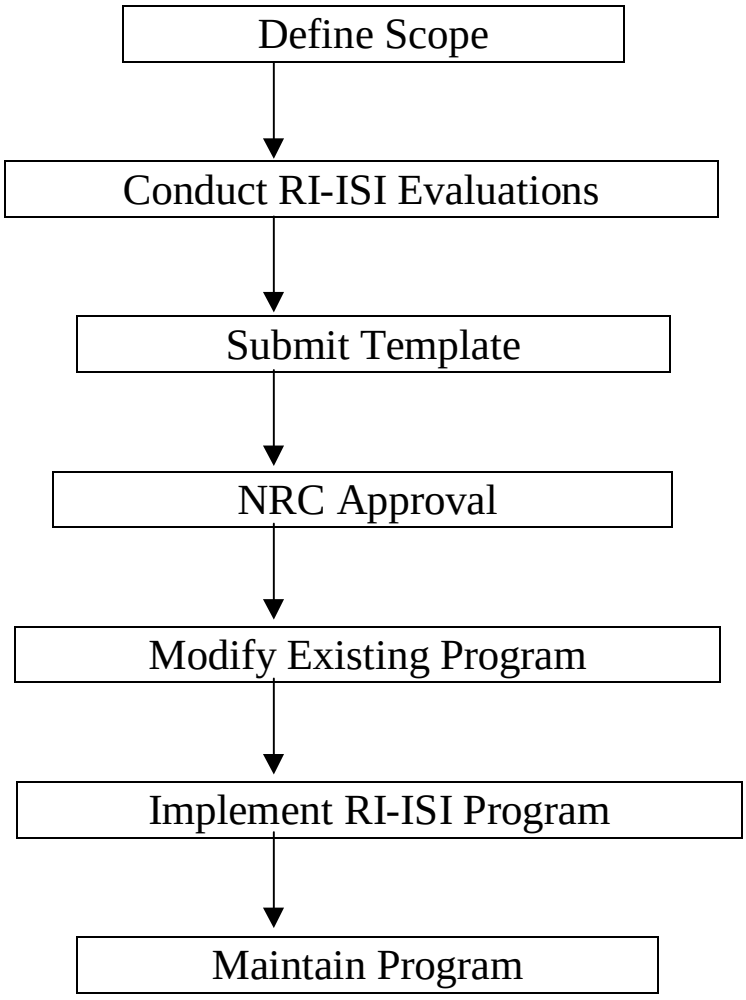


Figure 2-2. RI-ISI Project Process

Table 3-1 Integration of Inspection Programs

ISSUE	Integration Into RI-ISI Program
NUREG –0313, Rev 2 (IGSCC in BWRs)	Category A welds – Yes, fully Categories B- G - up to 50% may be credited towards the RI-ISI program.
NRC Bulletin 88-08, 'Thermal Stresses in Piping Connected to RCS"	Yes, specifically addressed by thermal fatigue evaluation
NRC Bulletin 88-11, "Pressurizer Surge Line Stratification"	Yes, specifically addressed by thermal fatigue evaluation
NRC Information Notice 93-020, "Thermal Fatigue Cracking of Feedwater Piping to Steam Generators"	Yes, specifically addressed by thermal fatigue evaluation
IE Bulletin 79-17, Pipe Cracks in Stagnant Borated Water Systems at PWR Plants	Yes, specifically addressed by stress corrosion cracking evaluation
Service Water Integrity Program (G.L. 89-13)	Yes, specifically addressed by localized corrosion evaluation
Flow Accelerated Corrosion (G.L. 89-08)	Yes, no change to the number, type or frequency of inspection

Table 3-2 Class 1 Application Results

Plant	Old SXI	RI-ISI	% Reduction
VY	126	34	73
ANO-1	200	38	81
Braidwood	203	74	64
STP-1	186	59	68
STP-2	155	59	62
Ave.	174	53	70

Table 3-3 ANO-2 Results

ANO-2	Old SXI	RI-ISI	% Red.
Inspections	332	100	70
Dose	84	8	90

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