INL/CON-07-12514
PREPRINT

# Advanced Test Reactor Design Basis Reconstitution Project Issue Resolution Process

## Safety Analysis Workshop

Steven D. Winter
Gregg L. Sharp
William E. Kohn
Richard T. McCracken

May 2007

# Advanced Test Reactor Design Basis Reconstitution Project Issue Resolution Process

Steven D. Winter
Gregg L. Sharp, William E. Kohn, Richard T. McCracken
Idaho National Laboratory / Battelle Energy Alliance
P.O. Box 1625
Idaho Falls, ID 83415-7136
Phone (208) 533-4264 / Fax (208) 533-4173
Steven.Winter@inl.gov

## Introduction

The Advanced Test Reactor (ATR) is a Department of Energy (DOE)-owned pressurized-water nuclear reactor whose principal function is to provide a high neutron flux for experiments involving reactor fuels and materials. The reactor also provides other irradiation services such as radioisotope production. The reactor has a design thermal power of 250 MW, a nominal operating pressure of 360 psig at the core inlet (top of core), and a nominal core inlet temperature of 125°F. The nominal core outlet temperature is 170°F at the design thermal power level. The ATR and its support facilities are located at the Reactor Technology Complex (RTC) of the Idaho National Laboratory (INL).

The original safety basis for the ATR was documented in a Safety Analysis Report (SAR) dated April 1965. The ATR Plant Protection System (PPS) and Technical Specifications Design Basis Report (DBR), dated May 1976, was prepared to support design of an upgraded PPS and development of technical specifications. The PPS includes the reactor shutdown system and the engineered safety features that were part of the facility at the time the DBR was prepared. The DBR contained analyses of accident sequences from which the performance requirements (setpoints and response times) for the PPS and technical specifications for initial conditions (pressure, temperature, flow, power) were derived. The DBR served as the facility accident analysis from 1976 until the upgraded SAR (SAR-153) was implemented in 1998. The DBR was maintained as a configuration controlled document with periodic updates. SAR-153 was prepared in response to requirements in DOE Order 5480.23 and now Title 10 of the Code of Federal Regulations, Part 830, Nuclear Safety Management for upgrading and maintaining a DSA describing the facility safety basis. SAR-153 development did not include a design basis reconstitution effort. Rather, SAR-153 built on the DBR and referred to the 1965 SAR. SAR-153 has been maintained via the annual update process as required by DOE regulations.

The Design Basis Reconstitution Program (DBRP) is part of the on-going ATR Life Extension Program (LEP). The purpose of the DBRP is to update and bring the ATR design basis to a level comparable to contemporary commercial nuclear power plants. The DBRP focuses on identification of system requirements and performance criteria essential to the system's performance of its safety function, the basis for the requirements, and how the current system configuration satisfies the functional requirements and criteria. In addition to establishing the baseline documentation important to the system's or structure's safety function, the functionality of the structures and systems will be validated.

The publications processing office has reviewed and released this document for publication (reference INL/CON-07-12514)

DBRP personnel are organized into several functional groups. DBRP team members include INL employees and individual sub-contractors. They are responsible for project administration, the issue resolution process, identifying historical documents, document reviews, evaluations, and accident analysis reviews. The DBRP assessment team includes the DBRP team members and an additional sub-contracted company. The sub-contracted company is responsible for schedule preparation, historical document review, identification of observations, system design description preparation and review, and system validation document preparation and review. The assessment team is responsible for system boundary definitions and system walkdowns.

The DBRP is designed to establish and document the ties between the Documented Safety Analysis (DSA), design basis, and actual system configurations. Figure 1 depicts these three major elements and their interrelationships. When the DBRP cannot establish a link as identified in Figure 1, a gap will be identified. The process of identifying, evaluating, reporting, and addressing these gaps, along with some lessons learned, is described in this paper.

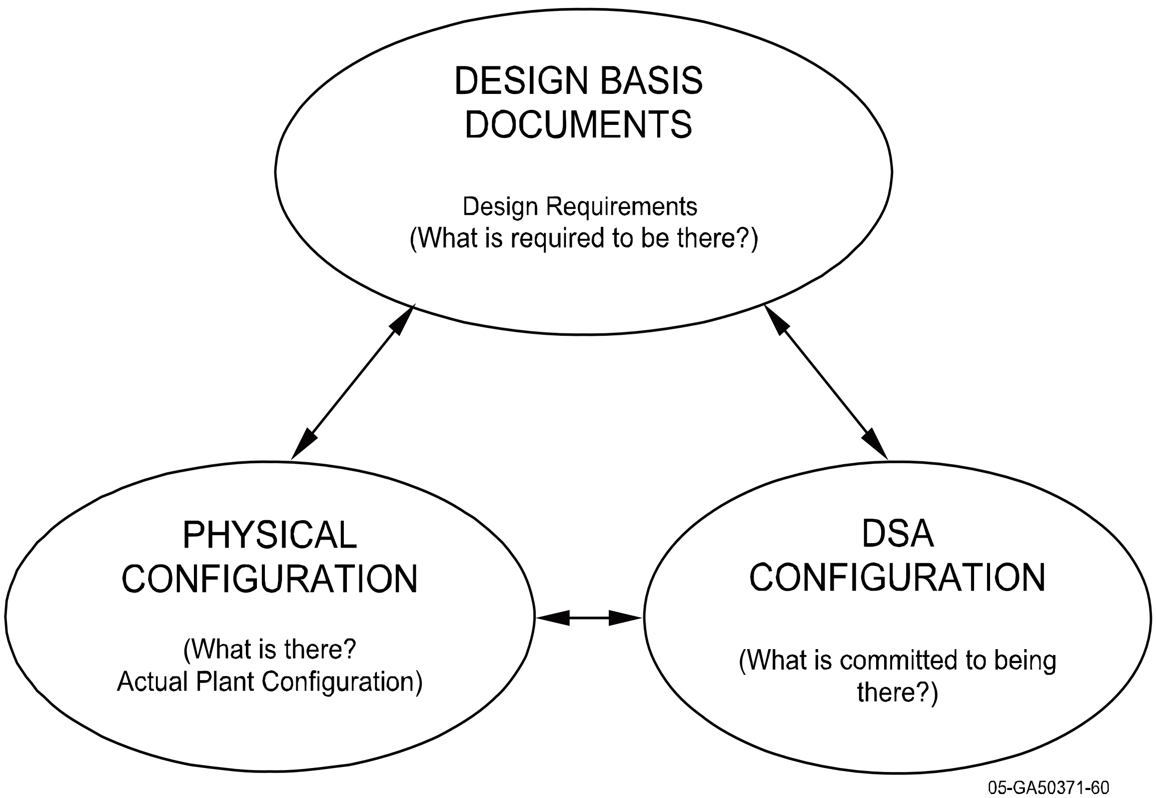


Figure 1 – Relationships Between the DSA, Design Basis Documents, & Physical Configuration.

## Resolution Process

The DBRP Issue Resolution Process was developed to provide a standard method of addressing the observations identified during the design basis reconstitution project. A standard process helps ensure that all observations are evaluated and that the timeliness expectations of the PISA (Potential Inadequacy in the Safety Analysis) process are met. This process is illustrated in Figure 2.

### Identification and Evaluation of Issues

The DBRP process includes a number of activities, including, but not limited to, identifying systems for evaluation, identifying historical documents and analyses-of-record, identifying system boundaries, reviewing documents for system design requirements, creating system design descriptions, performing system walkdowns, and validating design requirements. All of these activities have the potential to identify discrepancies, omissions, and other items of interest. These are referred to as observations.

DBRP observations are comments from DBRP team members resulting from the identification of design basis requirements, physical plant configuration validation, safety system functional validation, generation of design basis documents, or accident analysis verification. An observation arises when a discrepancy is noted or when one of the links shown in Figure 1 cannot be established.

The front end of the Issue Resolution Process includes those actions involved with identifying, categorizing, evaluating, and documenting DBRP observations. It also includes any PISA evaluations required for the observations. Front end actions are performed by DBRP assessment team members, facility safety analysts, and the ATR facility manager.

DBRP observations are discussed by the DBRP team members and, based on their knowledge and experience, are categorized as either physical plant discrepancies, DBRP questions, or confirmed gaps. Categorization is based on a consensus of the team members. If an observation cannot be placed into one of these three categories, it is not recorded. Once categorized, each observation is processed according to the plan. As of April 2007, 109 physical plant discrepancies, 4 questions, and 126 gaps have been identified by the DBRP.

#### *Physical Plant Discrepancies*

A physical plant discrepancy is a confirmed discrepancy between the actual physical configuration of the facility and the facility design documentation (typically plant drawings). The discrepancy is evaluated to determine whether or not it is a discrepant as-found condition. If it is, the discrepancy is subject to the INL Unresolved Safety Question (USQ) process and is considered to be a confirmed gap. It is subsequently entered into the gap database. If the discrepancy is not a discrepant as-found condition, it is assigned to an appropriate facility program (drawing control, nonconforming items, etc.) for resolution.

The publications processing office has reviewed and released this
document for publication (reference INL/CON-07-12514)

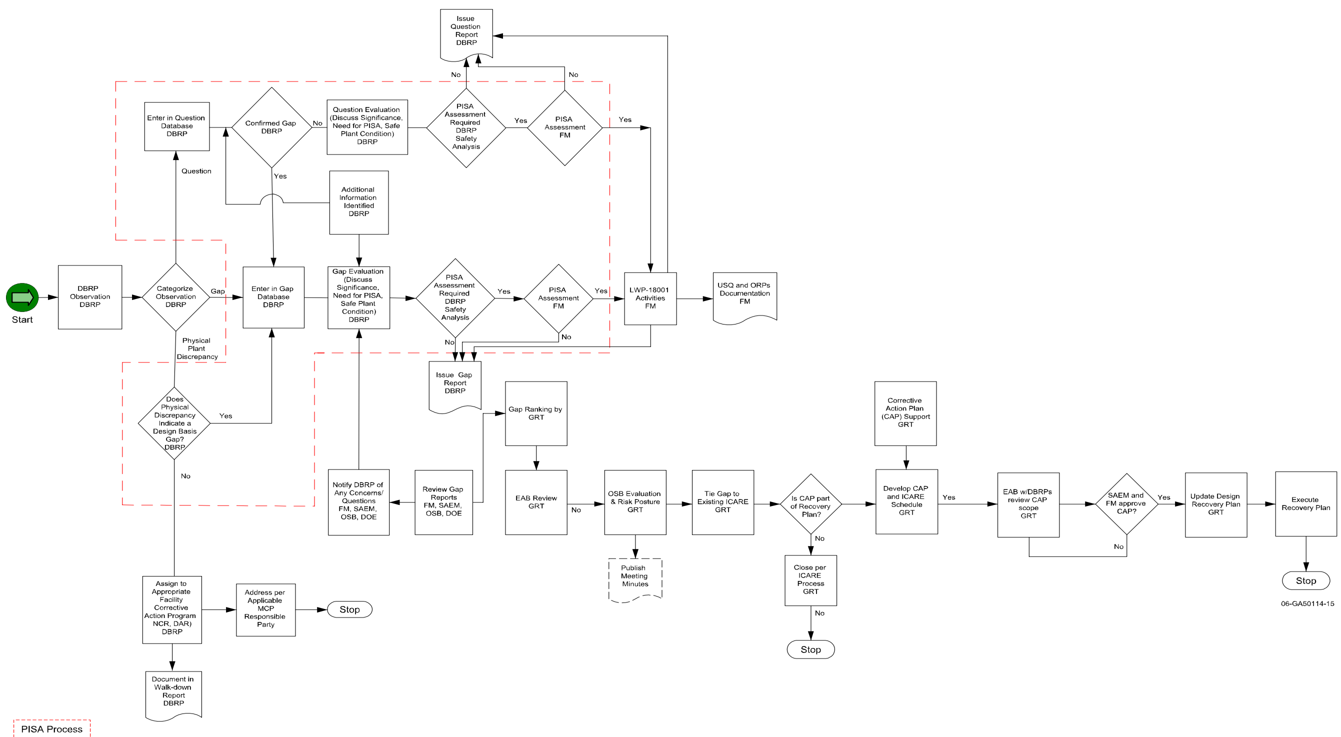


Figure 2 – Design Basis Reconstitution Program Issue Resolution Process.

The publications processing office has reviewed and released this document for publication (reference INL/CON-07-12514)

*Questions*

A DBRP Question is an observation that represents a potential break in the links in Figure 1 and requires further research to assess whether the observation constitutes a confirmed gap. Each question is entered into the DBRP question database. Required information includes the date of discovery, question name, question description, question evaluation, references to applicable documents, hyperlinks to pertinent documents in the Electronic Document Management System (EDMS), and the final disposition of the question. The question description is written to provide sufficient detail for review and evaluation of the question.

All questions are evaluated by DBRP team members. The evaluations provide additional detail about the question. If a question is determined to be a discrepant as-found condition, it is considered to be a confirmed gap and is entered into the gap database. If not, the evaluation documents whether a Potential Inadequacy in the Safety Analysis (PISA) assessment is required per the INL USQ procedure. The reasonability determination for the question, which is documented in the question evaluation, is completed using the best engineering judgment available at the time.

All new questions, their evaluations, PISA assessments, USQ evaluations, etc. are documented weekly in the DBRP question report. The report is distributed to the ATR Engineering Manager, The ATR Facility Manager, members of the ATR Operational Safety Board (OSB), and DOE-ID.

*Gaps*

A confirmed gap is a discrepancy in the facility design basis documentation that has been confirmed by consensus of the DBRP assessment team. Confirmed gaps are created directly from DBRP observations or from the review of physical plant discrepancies and/or questions. Each confirmed gap is entered into the DBRP gap database. Required information includes the date of discovery, gap name, gap description, gap evaluation, references to USQ documentation (if any), links to pertinent documents in EDMS, information on any corrective actions taken prior to entry into the corrective action system (ICARE), and a cross-reference to the ICARE number. The gap description is written to provide sufficient detail for review and evaluation of the gap.

As with questions, all confirmed gaps are evaluated by DBRP team members. The evaluations provide additional detail as well as consider the safety significance of the gap. The evaluation documents whether or not a PISA assessment is required per the INL USQ procedure and also performs the reasonability determination for the issue.

The PISA assessments for gaps/questions treat them as new information. The issue is assessed per the laboratory-wide USQ procedure. The PISA assessments are completed within hours to days per DOE G 424.1-1. Interim controls are imposed, if necessary, and a USQ determination completed. PISAs/USQs are reported through the ORPS system when appropriate.

The publications processing office has reviewed and released this
document for publication (reference INL/CON-07-12514)

**Reporting and Addressing Gaps**

The output of the front end of the Issue Resolution Process includes actions for resolving physical plant discrepancies, weekly question and gap reports, and USQ documentation. Other than the physical plant discrepancy actions, these documents feed information to the back end of the Issue Resolution Process.

The back end of the Issue Resolution Process includes those activities involved with reviewing gap reports, continually assessing the facility risk posture, developing corrective action plans, approving those plans, updating the design recovery plan, and executing the corrective action plans. Back end actions are largely performed by facility management personnel, the gap review team, and the engineering department.

Gap reports generated by the DBRP are reviewed by numerous stakeholders – the facility manager, the ATR engineering manager, the facility Operations Safety Board, and the DOE. Questions and concerns are fed back to the DBRP team for incorporation into gap and question evaluations.

The facility manager and the OSB meet quarterly, or as needed, to evaluate the confirmed gaps. Responsibility for various corrective actions is assigned during these meetings. Additionally, entry into the corrective action program (ICARE) is authorized for corrective action tracking. The overall risk posture of the facility is evaluated in light of the open questions and confirmed gaps.

The OSB review determines if there is a need for a focused gap/USQ resolution effort. Results of the reviews are documented in the gap database and the OSB meeting minutes.

*Ranking of Gaps*

New gaps are ranked by the ATR engineering manager, the engineering projects supervisor, and the nuclear engineering supervisor. The ranking process, which is under development, was implemented to help prioritize the large number of gaps expected from the DBRP. The ranking process assigns a numerical score to each confirmed gap based on a number of criteria (Table 1). Multiple criteria can apply to any given gap. The rank of a gap is the total number of points assigned by the ranking team. Gaps with a higher rank are intended to have a higher priority than those with a lower rank.

**Table 1**

| Criterion | Points |
|---|---|
| PISA – Reactor Shutdown | 100 |
| PISA – Limitations on Reactor Operations | 75 |
| PISA – Other interim controls | 50 |
| Positive USQ | 20 |
| TSR/SAR revision(s) | 15 |
| None of the above | 0 |

The publications processing office has reviewed and released this document for publication (reference INL/CON-07-12514)

**Gap Ranking Criteria & Points.**

Using the criteria in Table 1, many gaps will be assigned the same ranking. To better prioritize such gaps, each member of the ranking team also assigns a subjective point value to each gap. The subjective ranks are Very High (5 points), High (3 points), Medium (2 points), and Low (1 point). The subjective points provide a method of fine-tuning the rank of a gap which enables better prioritization and utilization of gap resolution resources. After ranking, the new gaps are added to the cumulative, overall list of ranked gaps.

The Engineering Advisory Board (EAB), which is comprised of the ATR Engineering Manager, his supervisors, the facility safety engineering supervisor, and a member of the Safety Operations Review Committee (SORC), reviews the ranked gaps and determines whether the ranking of a gap needs to be changed. The EAB determines which gaps will be incorporated into the Design Recovery Plan (DRP).

The Operations Safety Board (OSB) ensures that the guiding principles of integrated safety management are implemented in the ATR facilities. The OSB, which is chaired by the ATR Operations Manager and can include managers and supervisors from nearly every department on site, reviews the list of ranked gaps to agree with the assigned priorities. Changes can be made in the ranking of gaps. The ranking of the gaps, and the concurrence of OSB team members, is documented in the OSB meeting minutes.

The facility manager evaluates new and old gaps collectively to ensure the overall risk for safe operations is not exceeded.

*Corrective Action Plan for Gaps*

New gaps with positive USQ determinations are linked the existing ICARE numbers issued for those USQ determinations for traceability. All remaining gaps are assigned new ICARE numbers. If a gap is not to be resolved as part of the Design Recovery Plan, the relevant ICARE deficiency is turned over to the responsible department. If a gap is to be part of the Design Recovery Plan, corrective action plans are developed and are approved by the ATR Engineering Manager and the DBRP.

Corrective action plans and their associated schedules are entered into the Design Recovery Plan. The Design Recovery Plan, currently under development, supports resolution of deficiencies identified by the DBRP and other components of the Life Extension Program (LEP) – Material Condition Assessment, Seismic Assessment, Probabilistic Risk Assessment Upgrade. The DRP will establish priorities for resolution of LEP deficiencies. Factors to be considered in developing priorities include the availability of funding, support for future LEP activities, and consistency with planned and ongoing activities.

Corrective actions resulting from gap resolutions are monitored to ensure conflicts between resolution actions are resolved in a timely fashion. Schedule changes are also monitored for conflicts.

## Lessons Learned

The Design Basis Reconstitution Program Issue Resolution Process was developed to help ensure the timely processing and evaluation of gaps identified during DBRP activities. The process has been applied to numerous observations. Lessons learned to date include:

1) The Issue Resolution Process has integrated the USQ process into the processing of gaps. This has ensured that timeliness requirements have been met.

2) The Issue Resolution Process allows application of considerable knowledge and experience, via the Engineering Advisory Board and the Operations Safety Board, to issues identified by the DBRP. This has increased the visibility of issues and helped ensure the appropriate level of attention.

3) The Issue Resolution Process can be manpower intensive and may divert resources from other areas or projects.

4) The interface with the ATR Engineering Department (gap ranking & OSB review scheduling) has not worked as well as desired. A restructured interface is being considered.

5) Because of the need to perform frequent PISA assessments and USQ determinations, knowledgeable personnel need to be continuously involved in the issue resolution process.

## Conclusion

The Issue Resolution Process supports the DBRP and its purpose to update and bring the ATR design basis to a level contemporary with that of commercial nuclear power plants. The process provides a standardized method for categorizing observations, ranking confirmed gaps, and prioritizing their resolution. The process utilizes the experience and expertise of ATR engineering and operations support personnel to effectively accomplish gap identification and ranking activities. The process is also integrated with the approved laboratory USQ process and ensures timely application of the USQ process as required by DOE regulations.

The publications processing office has reviewed and released this
document for publication (reference INL/CON-07-12514)