FINAL SAFETY EVALUATION REPORT
FOR THE
LICENSING TOPICAL REPORT
WCAP-17573-NP, REVISION 1
WESTINGHOUSE SMALL MODULAR REACTOR
SMALL BREAK LOCA PHENOMENA
IDENTIFICATION AND RANKING TABLE
PROJ0797

Office of New Reactors
Division of Advanced Reactors and Rulemaking
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ACRS	Advisory Committee on Reactor Safeguards
ADS	Automatic Depressurization System
AOV	Air Operated Valve
AOO	Anticipated Operational Occurrence
ATWS	Anticipated Transient Without Scram
BAST	Boric Acid Storage Tank
CCA	Code Capability Assessment
CCFL	Counter Current Flow Limitation
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
CHR	Critical Heat Flux
CMT	Core Make-up Tank
CRDM	Control Rod Drive Mechanism
CSAU	Code Scaling, Applicability and Uncertainty
CV	Containment Vessel
CVCS	Chemical and Volume Control System
DBA	Design Basis Accident
DCA	Design Certification Application
DC	Direct Current
DCD	Design Control Document
DEGB	Double Ended Guillotine Break
DNBR	Departure from Nucleate Boiling Ratio
DVI	Direct Vessel Injection
ECCS	Emergency Core Cooling System
EM	Evaluation Model

EMDAP	Evaluation Model Development and Assessment Processes
ERI	Energy Research, Inc.
ESF	Engineered Safety Feature
FoM	Figure-of-Merit
GSI-191	Generic Safety Issue 191
HX	Heat Exchanger
ICP	In-Containment Pool
IET	Integral Effects Test
IFBA	Integral Fuel Burnable Absorber
IVR	In-Vessel Retention
LB	Large Break
LOCA	Loss-of-Coolant Accident
LOOP	Loss-of-Offsite Power
LTR	Licensing Topical Report
LWR	Light Water Reactor
MB	Medium Break
MSHIM	Mechanical Shim
MSIV	Main Steam Isolation Valve
NCG	Non-Condensable Gas
NRC	Nuclear Regulatory Commission
NRO	Office of New Reactors
OCP	Outside Containment Pool
PAR	Passive Autocatalytic Recombiner
PCT	Peak Cladding Temperature
PIRT	Phenomena Identification and Ranking Table
PRHR	Passive Residual Heat Removal
PWR	Pressurized Water Reactor
PSI	Pound per Square Inch
PSIA	Pound per Square Inch Absolute

PXS	Passive Core Cooling System
RAI	Request for Additional Information
RCP	Reactor Coolant Pump
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
RES	Office of Nuclear Regulatory Research
RFLB	Recirculation Feedwater Line Break
RG	Regulatory Guide
RPV	Reactor Pressure Vessel
RSLB	Recirculation Steam Line Break
SB	Small Break
SCV	Sump Coupling Valve
SDIV	Steam Drum Isolation Valve
SG	Steam Generator
SGDV	Steam Generator Depressurization Valve
SER	Safety Evaluation Report
SET	Separate Effects Test
SIT	Sump Injection Tank
SRP	Standard Review Plan
SSC	Systems, Structures and Components
TER	Technical Evaluation Report
W-SMR	Westinghouse Small Modular Reactor
UHS	Ultimate Heat Sink

1. INTRODUCTION

Westinghouse Electric Company, LLC (Applicant) previously planned[1] to submit its Westinghouse Small Modular Reactor (W-SMR) design to the United States Nuclear Regulatory Commission (NRC) for certification. As part of the pre-application phase, the Applicant submitted the Licensing Topical Report (LTR) WCAP-17573-P, "Westinghouse SMR Small Break LOCA Phenomena Identification and Ranking Table," to the NRC for review and approval (Ref.1).

The design of the W-SMR involves an integral configuration in which all primary system components (i.e., reactor core, internals, steam generators (except for steam drum), pressurizer, and control rod drive mechanisms) are inside the reactor pressure vessel (RPV). As a result, large pipe penetrations are not present in the RPV thereby eliminating the potential for Large/ Medium Break Loss-of-Coolant Accidents (LBLOCAs/MBLOCAs).

The LTR provides detailed documentation of the Phenomena Identification and Ranking Table (PIRT) developed by the Applicant under Small Break LOCA (SBLOCA) conditions in the W-SMR. The Applicant's purpose of the PIRT development is to identify phenomena of importance during a SBLOCA in the W-SMR in order to determine the technical adequacy and applicability of the Westinghouse evaluation model and the corresponding experimental database. Therefore, the PIRT process identified those phenomena as being highly important during a SBLOCA in the W-SMR but either were not included in the Applicant's Emergency Core Cooling System (ECCS) evaluation model or lacked a firm experimental basis to support further improvements to the ECCS evaluation model and the planned testing program.

After receiving the Applicant's LTR, the NRC's Office of Nuclear Regulatory Research (RES) formed and convened an independent PIRT panel consisting of NRC staff and consultants. The panel developed an independent SBLOCA PIRT for the W-SMR based on its own discussions and deliberations. The NRC staff issued several Requests for Additional Information (RAIs) to the Applicant during the independent PIRT development process. The Applicant's responses to these RAIs further informed the NRC/RES panel members about the specifics of the W-SMR design, the expected evolution of SBLOCA events, and Westinghouse's documented analysis results. This information was used by the panel members during the NRC's independent PIRT development process.

1.1 Background

This safety evaluation report is intended to document the NRC staff's findings based on the PIRT panel's review of the LTR (Ref.1) and Westinghouse's responses to various RAIs. The regulatory criteria used to guide the review are discussed below. Section 2 of this report provides a brief summary of the technical information provided by the Applicant in the LTR. Section 3 describes the safety evaluation performed by the reviewers, including a discussion of the responses to various RAIs. The overall regulatory evaluation and conclusions of the present review are given in Section 4.

The LTR (Ref.1) provides detailed documentation of the PIRT developed by the Applicant for the SBLOCA in the W-SMR. The Applicant's PIRT results are intended to form the basis for the further development of the Westinghouse evaluation model and the planned experimental testing program for the W-SMR.

[1] See Response to NRC Regulatory Issue Summary 2013-18 (ML14041A015).

A LOCA, as defined in Title 10 of the *Code of Federal Regulations* (CFR), Section 50.46(c)(1), "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors" (Ref.2), is a hypothetical accident that would result from the loss of reactor coolant, at a rate in excess of the capability of the reactor coolant makeup system, from breaks in pipes in the reactor coolant pressure boundary up to and including a break equivalent in size to the double-ended rupture of the largest pipe in the reactor coolant system.

There are five specific acceptance criteria for the ECCS identified in 10 CFR 50.46(b):

- *The calculated maximum fuel element cladding temperature shall not exceed 2200°F (1204°C; 1477K).*
- *The calculated total oxidation of the cladding shall nowhere exceed 0.17 times the total cladding thickness before oxidation.*
- *The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react.*
- *Calculated changes in core geometry shall be such that the core remains amenable to cooling.*
- *After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core.*

On September 16, 1988, the NRC amended the requirements of 10 CFR 50.46 so that these regulations reflect the improved understanding of ECCS performance during LOCA that was obtained through the extensive research performed since the issuance of the original requirements in January 1974. Paragraph 50.46(a)(1) permits licensees or applicants to use either the conservative approach in Appendix K to 10 CFR Part 50 or a realistic[2](or "best-estimate") evaluation model as explained in Regulatory Guide 1.157, "Best-Estimate Calculations of Emergency Core Cooling System Performance." (Ref.3)

If the realistic LOCA calculation approach is selected, 10 CFR 50.46 requires that "the evaluation model must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident. Comparisons to applicable experimental data must be made and uncertainties in the analysis method and inputs must be identified and assessed so that the uncertainty in the calculated results can be estimated." (Ref.3)

Regulatory Guide (RG) 1.157 (Ref.3) provides details of the NRC's expectations of an evaluation model that is used for realistic LOCA calculations and meets the requirements set

[2] For the purpose of Regulatory Guide 1.157, the terms "best-estimate" and "realistic" have the same meaning. Both terms are used to indicate that the techniques attempt to predict realistic reactor system thermal-hydraulic response. "Best-estimate" is not used in a statistical sense in Regulatory Guide 1.157.

forth in 10 CFR 50.46. The NRC's regulatory position for best estimate calculations in RG 1.157 (Section C.1) (Ref. 3) states that, "*A best estimate model should provide a realistic calculation of the important parameters associated with a particular phenomenon to the degree practical with the currently available data and knowledge of the phenomenon.*" As a result, it is important to determine the phenomena of importance and their current state of knowledge for LOCA scenarios used to show ECCS effectiveness.

RG 1.203, "Transient and Accident Analysis Methods," describes the NRC guidance on the evaluation model development process. A key element of the process is the development of a credible PIRT that forms the basis for the evaluation model development and assessment. The evaluation model development process laid out in RG 1.203, which includes the PIRT development process, derives from the Code Scaling, Applicability and Uncertainty (CSAU) effort of the NRC (Ref.4). The original concept for development and application of the PIRT during the CSAU effort was aimed at a LBLOCA in a pressurized water reactor (PWR). The application was considered to be successful and demonstrated the utility of the PIRT for the selecting and developing an ECCS performance evaluation model. Over the years, the PIRT methodology has been applied to several different scenarios, including SBLOCAs in PWRs.

The NRC staff conducted an audit in four phases at the Westinghouse Electric Company (WEC)'s Twinbrook offices during the following days: April 17, 2013, May 2, 2013, August 13, 2013, and October 24, 2013. The audit exit briefing was held on November 20, 2013 (Ref.13).

2. SUMMARY OF TECHNICAL INFORMATION

The LTR (Ref.1) documents the PIRT for an SBLOCA scenario in the W-SMR. The LTR includes sections that discuss the following subjects:

- W-SMR Plant Description
- SBLOCA PIRT Development Methodology and Approach
- SBLOCA Scenario PIRT Results
- Summary and Conclusions of the PIRT Process

Information contained in these sections of the LTR is summarized and briefly discussed in Sections 2.1 through 2.4 that follow. Note that only the information considered by the reviewers as being most pertinent to the LTR review, and not all the sub-sections present in the LTR, is summarized below.

2.1 Brief Description of the W-SMR Plant Design

LTR Section 1.1 includes an overview of key components of the W-SMR plant. The description of the W-SMR components, including the passive core cooling system, is supplemented with several figures. A schematic diagram of the W-SMR plant is shown in Figure 2.1. In addition, LTR Table 1-1 lists and describes the important W-SMR components. The breakdown of the components in Table 1-1 is used in the PIRT.

[

]a,c3

a,c

[

[3] Brackets and lettering denote information being withheld per 10 CFR 2.390.

[4] AP1000® is a trademark or registered trademark of Westinghouse Electric Company LLC, its affiliates and/or its subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

]a,c

LTR Section 1.4 lists the objectives of the SBLOCA PIRT as:

- To develop the functional requirements for the evaluation model for safety (LOCA) analyses for the SMR, and
- To develop a test matrix to provide the required evaluation model assessment database.

The review of the content of Section 1.1 of the LTR is provided in Section 3.1 of the present Safety Evaluation Report (SER).

2.2 SBLOCA PIRT Development Methodology and Approach

2.2.1 PIRT Methodology

The approach followed by the Applicant to arrive at the SBLOCA PIRT is described in LTR Section 2. In Section 2.1, the Applicant provides a historical background for the PIRT process and outlines a nine step approach for developing a PIRT. The initial steps in the PIRT development process, including the definition of the issue addressed by the PIRT, the PIRT objectives, identification of the plant and scenario of interest, and determination of the Figures-of-Merit (FoMs) used for ranking are described in LTR Section 2.2.

2.2.2 Westinghouse SBLOCA PIRT

LTR Section 2.2.1 documents the issue being addressed by the PIRT. The Applicant frames this issue in the context of ensuring a sufficient experimental and analytical database of information to support the licensing process required to obtain approval of any Evaluation Model (EM). The Applicant plans to use the results of the SBLOCA PIRT to undertake experiments in support of the EM assessment to address design phenomena questions in a hierarchical sequence such that the plant responses that are postulated to be of the highest safety significance are explored first. Section 2.2.2 reiterates the objectives of the SBLOCA PIRT from LTR Section 1.4 (reviewed in Section 3.1 of this SER).

The process requires that the entire reactor plant system being considered for the PIRT must be broken down into individual components to facilitate the phenomena identification and subsequent ranking. The component breakdown for the W-SMR provided in LTR Table 1-1 is used by the Applicant for the PIRT development.

In LTR Section 2.2.4, the representative SBLOCA scenarios that are considered for the PIRT are identified. All the candidate break locations corresponding to the major penetrations in the RPV are listed. [

]a,c The accident scenario is partitioned into logical time phases in which the phenomenological behaviors are reasonably similar. [

]a,c

The Applicant provides a detailed description of each phase along with the system behavior and events occurring during that phase in Table 2-1 of the LTR (Ref.1).

The FoMs that are used to determine and rank the relative importance of each phenomenon in the PIRT are provided in Section 2.2.5 of the LTR (Ref.1). The following FoMs are applicable across all the accident phases:
[

]a,c

The ranking scheme for the relative safety importance of the phenomena that was used by the PIRT panel assembled by the Applicant is provided in Section 2.2.7 of the LTR (Ref.1). Four rankings, 'High (H)', 'Moderate (M)', 'Low (L)' and 'Insignificant (I)' were used, accompanied by an explanation of what each of these rankings signifies (See Table 2-2 of the LTR).

The Applicant's PIRT panel also followed an operational practice described in LTR Section 2.2.7 for ranking the relative safety importance of components before assigning ranks to various phenomena. The same FoMs as those applied to the phenomena ranking were used for this purpose. The Applicant used this approach because they take the position that the approach was found to be useful because a phenomenon was not expected to have a higher rank than the component in which it occurred, thereby allowing the Applicant's panel to readily rank the relevant phenomena. In addition, the adopted operational approach also helped to determine the ranking sequence since phenomena associated with highly ranked components were ranked first, followed by phenomena associated with moderately ranked components and lastly, the phenomena associated with low importance components.

The ranking scale for the current state of knowledge for each phenomenon in the PIRT that was used by the PIRT panel assembled by the Applicant is provided in Section 2.2.8 of the LTR (Ref.1). Four ranking scales, 'High (H)', 'Moderate (M)', 'Low (L)' and 'Not Applicable (I)', were used. The explanation of the meaning of each of the knowledge level scales is provided in LTR Table 2-3. The LTR states that the scope of the Applicant's PIRT panel with regards to the determination of the state of knowledge was limited to a qualitative, experience-based assessment.

The review of the PIRT methodology and the scenario description is provided in Section 3.2 of this report.

2.3 SBLOCA PIRT Results

Section 3 of the LTR (Ref.1) contains the bulk of the material that forms the SBLOCA PIRT for the W-SMR design.

Table 3-1 in Section 3.1 in the LTR lists the plausible phenomena for each component considered by the Applicant's PIRT panel. Table 3-1 also includes an indicator for the description of the corresponding phenomenon. Table 3-2 in the LTR provides the explanation for each phenomenon description indicator.

An expected scenario progression for the [ ]a,c is provided in Section 3.2 of the LTR that is used for the phenomena ranking. Figures 3-1 through 3-5 in the LTR provide a schematic representation of the scenario progression described in LTR Section 3.2.

Table 3-3 in the LTR represents the final SBLOCA PIRT for the W-SMR design including the relative safety and knowledge level rankings for each of the component specific plausible phenomena listed in Table 3-1 in the LTR. The safety rankings are provided for each of the [ ]a,c phases of the accident along with a corresponding indicator for the ranking rationale. A single state of knowledge ranking for each phenomenon is also provided with a corresponding indicator for the ranking rationale. Tables 3-4 and 3-5 in the LTR explain, respectively, the rationale for each safety and knowledge ranking rationale indicator. The indicators for the rationale in Table 3-3 in the LTR can be cross-referenced with Tables 3-4 or 3-5 to determine the thought process of the Applicant's PIRT panel behind assigning the safety or knowledge rankings.

The review of the Applicant's SBLOCA PIRT rankings is provided in Section 3.3 of this report.

2.4 Summary and Conclusions of the PIRT Process

Section 4 of the LTR (Ref.) summarizes the conclusions reached based on the documented PIRT results in Table 3-3. The conclusions directly impact the selection and development of the evaluation model and the corresponding test program.

Based on the PIRT results, [ ]a,c are listed in Section 4.2 of the LTR (Ref.1) in their expected decreasing order of significance, in order to guide confirmatory experimental

testing, and continued analytical model development efforts. These components and the corresponding reasons for their significance are:
[

]a,c

Section 4.3 of the LTR describes the recommendations for treating phenomena that received a high safety ranking in at least one phase of a SBLOCA scenario and a low or moderate knowledge ranking.

Section 4.3.1 of the LTR includes Table 4-1 which lists all the phenomena from the PIRT with a high safety ranking and a low knowledge ranking and the corresponding method for addressing this disparity. The general approach for such phenomena is to increase the state of knowledge using planned experiments. In the majority of the cases the required information is obtainable
[

]a,c

Section 4.3.2 of the LTR includes Table 4-2 which lists all the phenomena from the PIRT with high safety ranking and a moderate knowledge ranking and the corresponding method for addressing this disparity. According to the Applicant, most of the required information can be obtained from [

]a,c

The review of this section of the LTR is documented in Section 3.3 of this SER. It is noted, however, that the review of the test plan, including the test facility scaling and test matrix, which is required to determine the acceptability of the proposed testing rationales as they relate to the EMDAP is not within the scope of the current LTR review.

Appendix A of the LTR entitled, "Westinghouse SMR SBLOCA PIRT Panel Organization and Members" include PIRT independent panel experts' curriculum vitae, PIRT Westinghouse experts' panel curriculum vitae, and Westinghouse SMR experts' curriculum vitae. Appendix B of the LTR describes the AP600 plant program test summaries. These Appendices are included for information only.

3. TECHNICAL EVALUATION

The review was performed by Office of New Reactors with the technical assistance of the Office of Nuclear Regulatory Research and their contractor, Energy Research, Inc.(ERI).

3.1 Westinghouse Description of the W-SMR Design

Section 1.1 of the LTR (Ref.1) provides an overview of the W-SMR plant design, its components, functions, and the intended operation of the ECCS. Several RAIs were formulated that requested specific details of the W-SMR design. Even though the LTR provides a description of the design, nonetheless, there are details and nuances that the reviewers considered important to developing a good understanding of the design before proceeding to evaluate the Applicant's PIRT. Furthermore, it is apparent from interactions with the Applicant that there are several areas where the design's attributes are still evolving. The information the Applicant provided in response to the staff's RAIs helped improve the reviewers' understanding of the W-SMR design. As mentioned earlier, NRC/RES also formed and convened an independent PIRT panel consisting of NRC RES staff and NRC consultants. The NRC panel developed an independent SBLOCA PIRT for the W-SMR based on their own deliberations. The RAI responses also helped the NRC panel to better understand the details of the W-SMR design. It should be noted that the RAIs seeking design information were formulated with the intent of understanding the system design to facilitate the LTR PIRT review and the NRC/RES PIRT development process. Therefore, the responses were evaluated solely on the basis of whether the requested information facilitated such endeavors. The staff's acceptance of the Applicant's RAI responses does not indicate an endorsement or approval of the design and operational features that form the subject of each RAI.

RAI-TR-SBLOCA-PIRT-1 (Ref.5) requested updated information supporting the LTR. In response, the Applicant provided a table that changed and supplemented important dimensions, locations, elevations, volumes, material specifications, operating conditions, system capacities, and applicable technical details. The staff found this information helpful in understanding the current state of the design and therefore, the response is acceptable.

RAI-TR-SBLOCA-PIRT-2 (Ref.5) requested the ICP operating pressure and the existence of any non-condensable gases (NCG). The Applicant's response describes the complement of ICPs and SITs and states that the operating pressure is [ ][a,c] It goes on to explain that non-condensable gases can be vented from the high point of the SITs as well as from each ICP, and [

][a,c] The response is acceptable because it provided the requested information.

RAI-TR-SBLOCA-PIRT-3 (Ref.5) requested the pressure difference used for the rupture disk at the top of the SITs. The Applicant's response states that the rupture disks serve as a protection against both over-pressurization and under-pressurization of the SITs and the ICP Tanks and that they are designed to rupture at [ ][a,c] As a follow-up, RAI-TR- SBLOCA-PIRT-40

(Ref.7) notes that in the response to RAI-TR-SBLOCA-PIRT-3(Ref.5) the opening pressure of the rupture disk is [ ][a,c] which would be more appropriate.

Since the SITs are initially at 14.7 psia, the initial pressure differential between the SITs and the containment can be considered as gauge pressure. However, the SIT pressure can change during an accident. The Applicant was asked to clarify whether the value in the response can be interpreted to be the differential pressure for the opening of the rupture disk throughout the accident. The Applicant's response states that indeed the pressure is differential as stated in the RAI and the value should be stated as [ ][a,c] The response is acceptable because it provided the required clarification.

RAI-TR-SBLOCA-PIRT-7 (Ref.5) requested a description and a diagram pertaining to the connections at the top of the SITs, clarification as to whether SITs are "water-solid" during operation, and if not, the volume of the gas space at the top. The Applicant's response provides a detailed schematic diagram showing the requested connections. The text of the response describes the operating philosophy of the SITs and ICPs. [

][a,c] The response provided the desired information and is acceptable.

RAI-TR-SBLOCA-PIRT-8 (Ref.5) requested clarification regarding the operation of the SITs/ICPs during injection, including the type and arrangement of the valves, the venting capability, and the cooling requirements. The Applicant's response describes the operation of [

][a,c] The response provided the desired information and is therefore acceptable.

This response also states that the SITs/ICPs are not expected to [

][a,c] The response to RAI-TR-SBLOCA-PIRT-8 (Ref.5) provided the requested clarifications on the operation of the SIT/ICP system and therefore it is acceptable.

RAI-TR-SBLOCA-PIRT-9 (Ref.5) requests clarification regarding the modeling of the AOV in the ICP injection line. In response, the Applicant elaborates that [

]a,c

The response provided the required information and therefore it is acceptable.

RAI-TR-SBLOCA-PIRT-10 (Refs.5 and 6) and the follow-up RAI-TR-SBLOCA-PIRT-53 (Ref.7) requested clarification on the potential for [ ]a,c Details on the components being designed to achieve this and remove any [ ]a,c were requested in RAI-TR-SBLOCA-PIRT-53 (Ref.7). In response, the Applicant states that a [ ]a,c In addition, technical specifications will set a maximum containment pressure and consequently [ ]a,c Containment pressure above the technical specification limit will require the operators to take corrective action. The response is acceptable because it provided the required information necessary to understand the W-SMR design. Note that the acceptability does not imply an endorsement of the use or efficacy of the components, operational features or operator actions.

RAI-TR-SBLOCA-PIRT-11 (Ref.5) noted local high points in the CMT balance line and asked for clarification regarding how the accumulation of NCG in the high point of the piping is managed. The Applicant's response explains that the CMT balance line is [ ]a,c The response is acceptable because it provided the requested information necessary to understand the W-SMR design.

RAI-TR-SBLOCA-PIRT-12 (Ref.5) requested clarification as to the maximum and nominal flow rate in the spray line from the RCP discharge to the pressurizer. The Applicant's response provided the minimum, nominal, and maximum flow rates as [ ]a,c respectively. The response is acceptable because it provided the requested information.

RAI-TR-SBLOCA-PIRT-14 (Ref.5) noted that the Sump Coupling Valves (SCVs) seem to be located at an elevation below the sump injection valves and requested confirmation and greater details. The Applicant's response provided a schematic of the Passive Core Cooling System (PXS) which includes the noted components. It also provided the elevations using standard nomenclature. The response provided the requested information and is acceptable.

RAI-TR-SBLOCA-PIRT-19 (Ref.5) requested information regarding the plenum spring length and spring force in the W-SMR fuel rods. The Applicant responded that this attribute of the design is still under review but stated that it will have design margins comparable to that of the AP1000 plant design. The response provided qualitative information that is sufficient for understanding the design and it is acceptable.

RAI-TR-SBLOCA-PIRT-20 (Ref.5) requested information regarding the design pressure of the containment. The Applicant's response is that the containment design pressure is 250 psig. The response provided the required information and is acceptable.

RAI-TR-SBLOCA-PIRT-21 (Ref.5) asked whether the SBLOCA analysis assumes coincident Loss of Offsite Power (LOOP) and if the reactor is designed to trip on LOOP. In response, the Applicant stated that the reactor is assumed to be at 100% power at the beginning of the accident. Furthermore, the response indicated that safety analysis calculations [

]a,c The response provided the clarification sought and is acceptable.

RAI-TR-SBLOCA-PIRT-22 (Ref.5) noted from some of the available Westinghouse LOCA analysis results that the ADS-2 steam quality is higher than one might expect and requested clarification. The Applicant's response states that since [

]a,c The response provided the clarification requested and is acceptable. The acceptability does not imply an endorsement of the design or the operational characteristics of the ADS-2.

RAI-TR-SBLOCA-PIRT-23 (Ref.5) and RAI-TR-SBLOCA-PIRT-42 (Ref.7) requested information regarding automatic trip functions and their setpoints. The Applicant's response provided a detailed list of trip functions and states further that at this time in the design process, the setpoints are still being established. The response is acceptable because it provided the requested information.

RAI-TR-SBLOCA-PIRT-61 (Ref.8) requested information on the method employed in the W-SMR to deal with hydrogen and oxygen generated as a result of radiolysis during potential accidents. The Applicant stated that [

]a,c The response is acceptable because it provided the requested information necessary to understand the W-SMR design. Note that acceptability of the RAI response does not indicate an endorsement of the use or efficacy of the components mentioned in the response.

RAI-TR-SBLOCA-PIRT-69 (Ref.9), RAI-TR-SBLOCA-PIRT-70 (Ref.9), and RAI-TR-SBLOCA-PIRT-73 (Ref.9) requested clarification of certain information presented in the LTR which appears to be inconsistent with the latest available information. Specifically, RAI-TR-SBLOCA-PIRT-69 requested clarification for the location of the squib valves applicable to in-vessel retention. The location of the valves as shown in the LTR is inconsistent with recent design presentations by the Applicant. Similarly, RAI-TR-SBLOCA-PIRT-70 raised the inconsistency in the nomenclature for the tanks connected to the ICPs. These tanks are called "top ICPs" or "ICP tanks" in the LTR whereas the most recent nomenclature is "Sump Injection Tanks" or "SITs." Tables 1-2 and 1-3 and Figure 1-2 in the LTR appear to reflect older design information and RAI-TR-SBLOCA-PIRT-73 requested updates to these based on the latest design information. The latest design information and terminology was used in the preparation of the NRC/RES SBLOCA PIRT. The differences between the NRC/RES and the Applicant's PIRTs due to the evolution of the design and analysis can cause confusion during comparison and review. In response to the above-mentioned RAIs, the Applicant confirmed the presence of cited inconsistencies and agreed to rectify the cited inconsistencies based on the current design and nomenclature in an approved version of the LTR, which will be submitted to the NRC after receipt of this final safety evaluation. The changes proposed by the Applicant in response to RAI-TR-SBLOCA-PIRT-69, RAI-TR-SBLOCA-PIRT-70, and RAI-TRSBLOCA-PIRT-73 are acceptable.

A datum for various elevations provided in Table 1-2 of the LTR is not indicated and was requested as part of RAI-TR-SBLOCA-PIRT-72 (Ref.9). In response to this RAI, the Applicant specified that the datum is the inside bottom of the containment vessel. The response is satisfactory. In addition, based on RAI-TR-SBLOCA-PIRT-73, the Applicant has also agreed to update LTR Table 1-2 using the latest design information and the resulting changes proposed by the Applicant are acceptable.

Section 1.2 of the LTR asserts that W-SMR safety components do not require AC power or operator action. RAI-TR-SBLOCA-PIRT-71 (Ref.9) requested information on the valve type and performance during loss of AC power for the CMT return (DVI) line and the ADS-1 to support this assertion. The Applicant responded by clarifying that the valves on the CMT return (DVI) line and the ADS-1 valves are [

]a,c This RAI response is acceptable because it provided the required information, which supports the assertion that no AC power is required for the operation of various safety systems.

The additional information provided in response by Westinghouse to various NRC RAIs has significantly improved the understanding of the W-SMR design and the Westinghouse PIRT as documented in the LTR (Ref.1).

3.2 Approaches to the SBLOCA PIRT Development

The scenario description and progression specified in Section 3.2 of the LTR appears to be inconsistent in several details as compared to the information presented by the Applicant in RAIs related to the design and from the results of their simulation of the [ ]a,c scenario.

The independent PIRT panel asked for detailed information on [ ]a,c scenario because that scenario is used for the PIRT documented in the LTR. RAI-TR- SBLOCA-PIRT-4, RAI-TR-SBLOCA-PIRT-5, and RAI-TR-SBLOCA-PIRT-6 (all Ref.5) requested details regarding the model used by the Applicant to analyze the [ ]a,c scenario, the description of the scenario, and analysis results. RAI-TR-SBLOCA-PIRT-4 (Ref 5) requested detailed inputs (including assumptions, initial conditions, ECCS setpoints, the credited Engineered Safety Features (ESFs), and operator actions, among others) and analysis results (e.g., event sequences) for the SBLOCA simulations performed by the Applicant. The response by the Applicant is detailed and provides a large amount of pertinent information. The Applicant describes the model used for the SBLOCA simulations. The model is developed for the WCOBRA/TRAC-TF2 code and represents [

]a,c The response also provides a discussion of the event progression for the [ ]a,c which is the representative SBLOCA simulated by the Applicant. The discussion is complemented by several figures showing the variation of key system parameters during the accident. An event sequence table is also provided. The Applicant also provides a list of the ECCS setpoints as requested in the RAI.

The information in the response to RAI-TR-SBLOCA-PIRT-4 (which includes the information requested in RAI-TR-SBLOCA-PIRT-5, and RAI-TR-SBLOCA-PIRT-6) is acceptable because it provided the requested information, which was useful to the NRC/RES PIRT panel in their deliberations. The NRC/RES PIRT panel used the results presented in response to RAI-TR-SBLOCA-PIRT-4 to supplement their knowledge of the scenario during the PIRT development and LTR review with the understanding that currently unapproved (i.e., by the

NRC) methods are used to generate the results. RAI- TR-SBLOCA-PIRT-41 (Ref.7) is a follow-up to RAI-TR-SBLOCA-PIRT-4 and requested clarification for several details related to the [ ][a,c] scenario described in response to RAI-TR-SBLOCA-PIRT-4. The Applicant's response to RAI-TR-SBLOCA-PIRT-41 (Ref.7) provides the required clarifications and is acceptable. Note that the review and use of the material presented in response to RAI-TR-SBLOCA-PIRT-4 and RAI-TR-SBLOCA-PIRT- 41 for the purpose of supplementing the knowledge of the NRC/RES PIRT panel does not constitute a review and approval of the results (including the evaluation model) contained in the responses.

Several inconsistencies between the information presented in Table 2-1 of the LTR [1] and the event sequence for the [ ][a,c] provided in response to RAI-TR-SBLOCA- PIRT-4 were raised in RAI-TR-SBLOCA-PIRT-74 (Ref.9). The scenario description during the blowdown phase (first phase) as given in Table 2-1 states that [ ][a,c] which appeared to be contradicted by the event sequence in response to RAI-TR-SBLOCA-PIRT-4 wherein the [ ][a,c] In addition, the description in Table 2-1 states that [ ][a,c] Based on the information provided by the Applicant in response to RAI-TR-SBLOCA-PIRT-2, it appears that the tanks communicate with the containment [ ][a,c] This RAI also seeks clarification of Section 3.2 of the LTR, which contains the same inconsistencies. In response to RAI-TR-SBLOCA-PIRT-74 (Ref.9), the Applicant agreed to address the inconsistencies noted in the RAI in the approved LTR, which will be submitted to the NRC after receipt of this final safety evaluation. The corresponding changes proposed by the Applicant are acceptable.

The response to RAI-TR-SBLOCA-PIRT-30 (Ref.5) indicates that the inadvertent ADS-1 or ADS-2 actuation event may be considered as a LOCA by the Applicant. In RAI-TR- SBLOCA-PIRT-50 (Ref.7) the reviewers questioned why these events are considered accidents as opposed to AOOs. In the response, the Applicant described the inadvertent ADS operation as an accident based on the design and [ ][a,c] The response is acceptable as it provided the rationale for considering the inadvertent ADS operation as an accident. Note that a detailed review of the technical basis for the Applicant's classification of the scenario including [ ][a,c] used was not considered to be part of the scope of either the PIRT LTR review or the NRC/RES SBLOCA PIRT development process. Therefore, the acceptability of the response to RAI-TR-SBLOCA- PIRT-50 is not intended to indicate the acceptability of the technical basis for the Applicant's scenario classification. Based on the Westinghouse response, the NRC/RES PIRT panel considered the spurious activation of either an ADS-1 or ADS-2 valve in determining the representative SBLOCA scenario. The Applicant has also included this accident in the selection of the SBLOCA scenario for the LTR PIRT. The Applicant considered [ ][a,c] to be more limiting than the spurious activation of either an ADS-1 or ADS-2 valve [ ][a,c] The NRC/RES PIRT panel also reached a similar conclusion using NRC/RES independent PIRT process.

Figure 2-3 of the LTR shows the variation of the FoMs chosen by the Applicant during various phases of the representative SBLOCA.

The phase definitions and the variation of the FoMs during each phase as shown in Figure 2-3 is inconsistent with the analysis results presented in the response to RAI-TR-SBLOCA-PIRT-4. Similarly, the event descriptions in Figures 3-2 through 3-5 of the LTR also appear to be inconsistent with the event timings provided in response to RAI-TR-SBLOCA-PIRT-4. The Applicant was requested to address these inconsistencies in RAI-TR-SBLOCA-PIRT-75 (Ref.9). Since the NRC/RES SBLOCA PIRT panel referenced the system response documented in RAI-TR-SBLOCA-PIRT-4 during their deliberations, it is important to resolve any inconsistencies with the information in the LTR. In response to the RAI, the Applicant agreed to update the LTR to address the inconsistencies noted in the RAI. However, the update to Figures 3-2 and 3-3 of LTR proposed by the Applicant do not appear to reflect the sequence of events accurately.

According to the response to RAI-TR-SBLOCA- PIRT-74 (Ref.9), the Applicant agrees that the [ ]a,c Similarly, the response to RAI-TR-SBLOCA-PIRT-74 also states that there is [ ]a,c The updated version of Figure 3-2 proposed by the Applicant does not appear to capture these changes and continues to state that the [ ]a,c Therefore, follow-up RAI-W SMR Test Plan and Scaling-80 was formulated to request that the Applicant make appropriate changes to Figures 3-2 and 3-3 of the LTR. The Applicant proposed to modify Figures 3-2 and 3-3 of the LTR in response to the follow-on RAI. Specifically, the Applicant stated that the last entry of the updated Figure 3-2 will indicate, [ ]a,c Figure 3-3 of the LTR is proposed to be modified so as to identify that the [ ]a,c The Applicant's changes and their implementation, as shown in the revised response to RAI-TR-SBLOCA-PIRT-103, are acceptable because it resolves the issue in the follow-up RAI, as stated above.

3.3 SBLOCA PIRT Results

The PIRT documented in Section 3.3 of the LTR has been reviewed. The review covered the importance and knowledge rankings and the corresponding rationales. The NRC/RES SBLOCA PIRT, which was developed independent of the LTR PIRT, was also compared against the results in Section 3.3 of the LTR during the review process. Several RAIs were formulated seeking explanation of the ranking rationale by Westinghouse, especially in cases where marked differences were observed as compared to the NRC/RES SBLOCA PIRT.

RAI-TR-SBLOCA-PIRT-65 (Ref.8) requested clarification on inconsistencies noted between the ECCS activation setpoint (with delay) and the sequence of events documented in the event sequence table provided as part of the response to RAI-TR-SBLOCA-PIRT-4. These inconsistencies were pointed out for the activation of the Steam Generator Depressurization Valves (SGDVs) and the closure of the Steam Drum Isolation Valves (SDIVs). In response, the Applicant acknowledged the identified inconsistency and provided updated versions of the ECCS activation and event sequence tables. Therefore, the response is acceptable.

Section 3.2 of the LTR mentions that the [ ]a,c This description is inconsistent with the information provided in response to RAI-TR-SBLOCA-PIRT-4 where [ ]a,c In addition, the above-mentioned statement on the opening of the valves in Section 3.2 of the LTR was also found to be inconsistent with a statement in the same section which mentions that [ ]a,c RAI-TR-SBLOCA- PIRT-76 (Ref.9) requested that the Applicant address these inconsistencies. In response, the Applicant agreed to address the inconsistencies in the approved LTR, which will be submitted to the NRC after receipt of this final safety evaluation. The corresponding changes proposed by the Applicant are acceptable.

RAI-TR-SBLOCA-PIRT-9 noted that the AOV in the ICP injection line does not appear to be considered as part of the analysis provided by Westinghouse. The Applicant's response states [ ]a,c The response is acceptable as it provided information about the approach used by the Applicant, which was sufficient for the purpose of LTR PIRT review.

RAI-TR-SBLOCA-PIRT-51 (Ref.7) and RAI-TR-SBLOCA-PIRT-55 (Ref. 8) questioned the Applicant's characterization of the DVI break as a double-ended guillotine break because of the presence of an [ ]a,c valve on the broken DVI line. This valve is normally closed and opens on the receipt of an activation signal. Therefore, the accident would be a single-ended break until the activation signal is received after which it would become double-ended. The analysis provided as part of RAI-TR-SBLOCA-PIRT-4 [ ]a,c As a result, neither is the review of the LTR adversely impacted nor does the NRC/RES PIRT need to be revised. RAI-TR-SBLOCA-PIRT-66 (Ref.8) requested a simulation of a realistic DVI break SBLOCA scenario. The Applicant provides results of the requested calculation in response to RAI-TR-SBLOCA-PIRT-66. These results confirm that even though event timings are altered as compared to the results presented in RAI-TR-SBLOCA-PIRT-4, nonetheless, the differences are not significant and the overall behavior of the system does not change appreciably. The Applicant further stated that [ ]a,c The response to RAI-TR-SBLOCA-PIRT-66 is acceptable as it provided the necessary information thereby also closing RAI-TR-SBLOCA-PIRT-51 and RAI-TR-SBLOCA-PIRT-55.

RAI-TR-SBLOCA-PIRT-56 (Ref.8) requested timing information on ADS-1 and ADS-2 flow transition from sonic to sub-sonic, draining of the pressurizer, and collapsed water level progression. The Applicant provided the specific times for the transition of the break and ADS-1 flow from sonic to sub-sonic. The Applicant also clarified that the ADS-2 flow [ ]a,c The response included a figure showing the draining of the pressurizer and the time at which it is calculated to be empty. In addition, the Applicant stated that even though the [ ]a,c The response provided the requested information and is acceptable.

RAI-TR-SBLOCA-PIRT-59 (Ref.8) requested information on the possible flooding of the break. In response, the Applicant states that their simulations show that the [

]^{a,c} The response is acceptable because it provided the requested information. Both the LTR PIRT and the NRC/RES SBLOCA PIRT rank the importance and knowledge of the phenomena of reverse flow from the containment to the RPV via the break, and the resulting transport of solids and chemicals into the RPV. Although the response to RAI-TR-SBLOCA-PIRT-59 implies that the [ ]^{a,c} inclusion of related phenomena in the PIRTs addresses any uncertainties in predictions and expands the applicability of the PIRTs. The response provided the requested information and is acceptable.

The [ ]^{a,c} RAI-TR-SBLOCA-PIRT-60 requested the Applicant to elaborate on the importance of this phenomenon, and to explain the approach that is planned to be used to determine [ ]^{a,c} In response, the Applicant has provided information on the [ ]^{a,c} The response is acceptable on the basis that it provided the requested description of the Applicant's approach. The Applicant intends to perform testing for [ ]^{a,c} The staff requested that the Applicant submit the test data related to [ ]^{a,c} The Applicant must ensure that the [ ]^{a,c} is treated realistically and appropriately in future analysis and testing submittals.

RAI-TR-SBLOCA-PIRT-8 (Ref.5) requested clarification of the type and operation of the valves on top of the SITs and on the sump injection lines connecting the ICPs to the RPV. The response states that [ ]^{a,c} on each sump injection line. These valves isolate each group of SIT and ICP tanks from the RPV. [ ]^{a,c}

[ ]^{a,c} The response provided the necessary information and clarification; therefore, it is acceptable.

RAI-TR-SBLOCA-PIRT-13 (Ref.5) requested clarification on the path available for liquid from the containment sump to enter the RPV. The response provided details of the path along with an accompanying figure. [

]a,c The response provided the necessary information; therefore, it is acceptable.

RAI-TR-SBLOCA-PIRT-15 (Ref.5) requested information on any sensitivity calculations performed by the Applicant to ascertain the importance of phenomena for the purpose of PIRT rankings. The Applicant's response provided details of sensitivity studies performed during the W-SMR design development. [
]a,c However, as described in the response, insights from these studies contribute to the Applicant's PIRT development. The response provides additional insight into the relative importance of phenomena and was beneficial to the NRC/RES panel deliberations on the SBLOCA PIRT and the LTR review. [

]a,c The response provided the requested information and is acceptable.

RAI-TR-SBLOCA-PIRT-16 (Ref.5) requested details of the debris profile expected in the W- SMR during an SBLOCA such as the [ ]a,c scenario. The Applicant states that it expects the debris during an SBLOCA to consist of:
[

]a,c

The Applicant contends that [

]a,c

The information contained in the response to RAI-TR-SBLOCA-PIRT-16 is acceptable as it provides the required information. However, the Applicant's assertion [
]a,c needs to be confirmed as part of the PIRT confirmation process.

In response to RAI-TR-SBLOCA-PIRT-17 (Ref.5), the Applicant states that [

]a,c

According to the event description in the LTR and the response to RAI-TR-SBLOCA-PIRT-4,

[

][a,c] RAI-TR-SBLOCA-PIRT-54 (Ref.7) requested clarification of the trigger for initiation of Phase 4 and, in particular, [
][a,c] In addition, it also requested the timings for the completion of each phase based on the analysis results provided in response to RAI-TR-SBLOCA-PIRT-4. The response is acceptable.

In response to RAI-TR-SBLOCA-PIRT-54, the Applicant provides a figure that shows [

][a,c] The Applicant also provides the timing for the completion of the phases based upon the analysis results in response to RAI-TR-SBLOCA-PIRT-4. The response is acceptable and the phase completion times provided by the Applicant have been used for the NRC/RES PIRT development.

RAI-TR-SBLOCA-PIRT-18 (Ref.5) requested the Applicant to describe the process that will be followed by the Applicant to change the importance rankings in the W-SMR SBLOCA PIRT based on the results of the planned integral and separate effects tests. The response states that [

][a,c] The response is acceptable because it provided the requested details.

Justification was sought for the importance ranking for the phenomenon of "[

][a,c] As a result, this phenomenon was ranked as being of 'Medium' importance in phases 2 through 4 in the NRC/RES SBLOCA PIRT. In response to the RAI, the Applicant clarified that the phenomena is [

][a,c] The importance ranking for this phenomenon on the outside shell of the containment vessel in the NRC/RES SBLOCA PIRT is 'Medium' for Phase 3 while being 'Low' for all other phases. The 'Medium' importance rank in Phase 3 in the NRC/RES SBLOCA PIRT was due to the activation of the ADS resulting in a large discharge of steam to the containment. In addition, the steam discharge may introduce non-uniform effects due to the staggered opening of the ADS-1 and ADS-2 valves. The Applicant provided sufficient technical justification for their ranking.

In response to RAI-TR-SBLOCA-PIRT-77 the Applicant further states that the phenomenon of [

][a,c] For consistency, the Applicant agreed to update the LTR to include phenomenon V.1.b in the section A.1 without any change to the importance ranking for the subject phenomenon. Based on the clarification, importance ranking for [ ]a,c is higher in the Applicant's PIRT as compared to the NRC/RES SBLOCA PIRT. The response to the RAI and the corresponding changes proposed by the Applicant are acceptable.

The phenomena of [ ]a,c The knowledge ranking is questioned in RAI-TR-SBLOCA-PIRT-78 (Ref.9) because this issue is highly design specific. [ ]a,c It is for these reasons that the NRC/RES SBLOCA PIRT assigned a 'Low' knowledge rank to these phenomena. Results from any CFD calculations performed by the Applicant to assign the knowledge ranking are also sought in RAI-TR-SBLOCA-PIRT-78.

The response to RAI-TR-SBLOCA-PIRT-78 cites [ ]a,c

Therefore, follow-up RAI-W SMR Test Plan and Scaling-81 was formulated that requested the Applicant to provide justification for the [ ]a,c Specifically, the Applicant was asked to explain the rationale for [ ]a,c

In response to RAI-W SMR Test Plan and Scaling-81 (Ref.12), which is a follow-up to RAI-TR-SBLOCA-PIRT-78, the Applicant qualifies the original response and provides additional details of the planned approach to resolving the gaps in knowledge created by the unique W-SMR containment design. [ ]a,c

According to the Applicant, [ ]a,c is deemed sufficient to qualify the safety analysis models for the W-SMR. The Applicant's contention [

][a,c] However, requesting and reviewing [ ][a,c] is beyond the scope of this report. Use of data from the planned W-SMR specific IETs is considered appropriate for the validation and verification of the analysis tools.

However, it is necessary to carefully review the scaling basis for the [

][a,c] A review of the scaling basis for the Applicant's planned IET facility is outside the scope of the current work. In addition to the above, the Applicant also stated in the response to RAI-W SMR Test Plan and Scaling-81 that [

][a,c] However, the responses to RAI-TR-SBLOCA-PIRT-01 and RAI-TR-SBLOCA-PIRT-53 (Ref.7) indicate that a [ ][a,c] is allowed for operation and safety analysis. The higher end of this range was considered in the NRC/RES PIRT resulting in a 'Medium' importance ranking for the phenomena [ ][a,c]

The [ ][a,c] that is present in the W-SMR design should be accounted for in the experiments as well as the planned model validation studies. In summary, the response to RAI-W SMR Test Plan and Scaling-81 is acceptable because the Applicant has provided a clarification of the planned course of action and it has addressed the concerns outlined in the RAI. However, as discussed above, the Applicant's approach needs to be reviewed to establish the applicability to the [ ][a,c]

Therefore, it is requested that any past data used by the applicant to qualify the analysis tools for application to the [ ][a,c] are reviewed by Westinghouse to ensure that the expected range of [ ][a,c] conditions are encompassed by such data. These conditions should include the [ ][a,c] In addition, it is also recommended to review the scaling for the Applicant's planned IET facility to ensure that the [ ][a,c] are adequately captured in the IETs. Moreover, the boundary conditions of the test should also reflect [ ][a,c] The Westinghouse PIRT includes and ranks the phenomenon of [ ][a,c] Design information is [ ][a,c] The model documented in response to RAI-TR-SBLOCA-PIRT-4 [ ][a,c] as confirmed by the response to RAI-TR-SBLOCA-PIRT-16 (Ref.5). Based on the design description and the results of RAI-TR-SBLOCA-PIRT-4 available to the NRC/RES PIRT panel, [ ][a,c] were not considered in the NRC/RES SBLOCA PIRT.

RAI-TR-SBLOCA-PIRT-79 (Ref.9) requested the rationale for including the aforementioned phenomenon/component in the Westinghouse PIRT. In the response, the Applicant clarified that the current W-SMR design [ ][a,c] which is the subject of the RAI (A.1.L) from Table 3-3 in the LTR. The corresponding change proposed by the Applicant is acceptable.

The analysis results made available by Westinghouse in response to RAI-TR-SBLOCA- PIRT-4 indicate that [ ][a,c] The response to RAI-TR-SBLOCA-PIRT-21 (Ref.5) also indicates this. [

]^{a,c}
Clarification on these issues was sought in RAI-TR-SBLOCA-PIRT-80 (Ref.9). [

]^{a,c} The response and the corresponding change proposed by the Applicant are acceptable. Due to the change, [
]^{a,c} is consistent between the NRC/RES and the LTR PIRTs. The Applicant has retained a [
]^{a,c} in contrast to the NRC/RES SBLOCA PIRT. However, the difference in rankings is in the conservative direction and is acceptable. In addition, the highest importance ranking accorded to [ ]^{a,c} is the same between the NRC/RES and Applicant's PIRT.

Both [

]^{a,c} in the Westinghouse PIRT. The rationale for the rankings (P14 in LTR Table 3-4) states that these phenomena are [

]^{a,c}
Additional details on the rationale for these rankings in the Westinghouse PIRT were requested in RAI-TR-SBLOCA-PIRT-81. (Ref.9) In the response the Applicant agreed with the rationale presented in the RAI. The Applicant agreed to update the LTR by assigning a [
]^{a,c} to both phenomena B.3.a and B.3.b in Table 3-3 of the LTR.

The knowledge ranking for these phenomena will be retained as being [ ]^{a,c} by the Applicant. The Applicant will revise the rationale for the importance rankings to indicate that the phenomenon is important to the FoM. The response and the proposed changes are acceptable. The changes make the updated importance ranking for [
]^{a,c} in the LTR PIRT higher than that in the NRC/RES SBLOCA PIRT. However, the difference in rankings is in the conservative direction and acceptable.

The phenomenon of [
]^{a,c} component in the PIRT in the LTR. The rationale for the importance ranking (P23 in LTR Table 3-4) is attributed to the [
]^{a,c} This is considered highly unlikely during the representative SBLOCA by the NRC/RES PIRT panel. Therefore, this phenomenon was not considered in the NRC/RES PIRT. As a result, additional details on the bases for the inclusion of the phenomenon and its ranking rationale such as [

]^{a,c} were sought in RAI-TR-SBLOCA-PIRT-82 (Ref.9). In response, the Applicant agreed to remove [
]^{a,c} from the PIRT in the approved LTR, which will be submitted to the NRC after receipt of this final safety evaluation. Therefore, the response and the corresponding changes proposed by the Applicant are acceptable.

The importance ranking for [ ]^{a,c} component

(B.7.b in LTR Table 3-3) is questioned in RAI-TR-SBLOCA-PIRT-83 (Ref.9). The importance ranking for that phenomenon is [ ]^a,c of the accident in the LTR. However, the [

]^a,c The NRC/RES SBLOCA PIRT ranks the [ ]^a,c as 'Medium' importance.

[

]^a,c The response and the corresponding changes to the LTR are acceptable.

[

]^a,c On the basis of the analysis results presented in response to RAI-TR-SBLOCA-PIRT-4, [ ]^a,c Therefore, [ ]^a,c was considered unlikely in Phase 1 and assigned a 'Low' importance rank in the NRC/RES SBLOCA PIRT.

Explanation on the potential for [ ]^a,c of the accident was sought in RAI-TR-SBLOCA-PIRT-84 (Ref.9). In response, the Applicant agreed that [ ]^a,c Therefore, the importance ranking for this phenomenon is proposed to be changed to [ ]^a,c The corresponding rationale is also proposed to be revised accordingly. The response and the proposed changes to the LTR are acceptable. The NRC/RES SBLOCA PIRT assigns a 'Low' importance ranking to [ ]^a,c in all phases of the accident.

The NRC/RES panel considered it unlikely that [ ]^a,c is prevalent due to the relatively large hydraulic diameter of the upper plenum. The [ ]^a,c in the Westinghouse PIRT is conservative as compared to the NRC/RES SBLOCA PIRT and is acceptable.

The phenomenon of [ ]^a,c in the PIRT in the LTR. The corresponding rationale [ ]^a,c This inconsistency was raised in RAI-TR- SBLOCA-PIRT-85 (Ref.9). In addition, the rationale does not account for the potential that [ ]^a,c An explanation for not including this possibility was also sought in RAI-TR- SBLOCA-PIRT-85. In the response, the Applicant clarified that the [ ]^a,c The Applicant agreed to revise the rationale for phenomenon C.1.b in the LTR to reflect this as well as the [ ]^a,c The response and the changes resulting from this RAI as proposed by the Applicant are acceptable. It is noted that the NRC/RES SBLOCA PIRT assigned a 'Low' importance to the phenomenon of

[ ]^{a,c} The NRC/RES panel considered [ ]^{a,c} as unimportant in Phases 1 and 2 since [ ]^{a,c} are not likely. During Phase 3 although the [

]^{a,c} the NRC/RES PIRT panel did not expect an appreciable impact on the FoMs which are driven by overall flow rate through the upper plenum. The importance rankings for [ ]^{a,c} for the Westinghouse PIRT for Phases 1 and 3 are in a conservative approach and are acceptable.

The importance ranking for [

]^{a,c} Therefore, clarification on the rationale for the importance ranking for phenomenon C.4.d in LTR Table 3-3 in Phase 4 was sought in RAI-TR-SBLOCA- PIRT-86 (Ref.9). It is noted that the NRC/RES SBLOCA PIRT assigned a 'Low' importance to this phenomenon for all the accident phases due to the reasons described above. The RAI was issued although the difference in the importance rankings between the NRC/RES and the Applicant's PIRT in Phase 4 is in the conservative direction to understand if details of the system behavior were overlooked by the NRC/RES panel. In response the Applicant provides justification for the [ ]^{a,c} importance ranking. The Applicant states that there is a [

]^{a,c} The justification provided by the Applicant is acceptable. As indicated above, the difference in the importance rankings between the NRC/RES and the LTR PIRTs in Phase 4 is in a conservative approach.

Additional justification related to the rationale for ranking [ ]^{a,c} (D.2 in LTR Table 3-3) was sought in RAI-TR-SBLOCA-PIRT-87 (Ref.9). The LTR discusses the impact of the phenomenon due to [ ]^{a,c} NRC/RES considers the potential for [ ]^{a,c} to be minimal in Phase 2 of the accident.

Therefore, the NRC/RES PIRT panel assigned a 'Low' importance ranking to this phenomenon for all phases. The RAI was issued, considering that the difference in the importance rankings between the NRC/RES and the LTR PIRT in Phase 4 is in the conservative direction, in order to understand if details of the system behavior were overlooked by the NRC/RES panel.

In response, the Applicant agreed that [ ]^{a,c} The Applicant further agreed to change the ranking for phenomenon D.2 Table 3-3 of the LTR during Phase 2 to 'Low.' The response and the proposed change are acceptable. The ranking for the [ ]^{a,c} phenomenon across the accident phases will be consistent between the NRC/RES and the Westinghouse PIRT following the proposed changes.

The knowledge ranking for the phenomenon of [

]^{a,c}

make testing or, at least, detailed calculations necessary to understand the performance of the separation plates. Even though the behavior of the [ ]^{a,c} the lack of test data makes this claim unsubstantiated. Due to these reasons, justification for the rationale for the knowledge ranking for the above-mentioned phenomenon was sought in RAI-TR-SBLOCA-PIRT-88 (Ref.9). The NRC/RES SBLOCA PIRT ranked the knowledge level for [ ]^{a,c} due to the unique design and the need for testing. The Applicant agreed that the knowledge ranking for the phenomenon identified in the RAI should be [ ]^{a,c} The Applicant further agreed to change the ranking and the corresponding rationale. The changes to the knowledge ranking are acceptable. However, the Applicant also stated that the importance ranking for the phenomenon is [ ]^{a,c}

The changes resulting from this RAI as proposed by the Applicant also show that the importance ranking for phenomenon E.1 in LTR Table 3-3 will be changed [ ]^{a,c} No justification for the change in the importance ranking has been provided. The importance ranking was never questioned in the original RAI. Detailed justification for decreasing the importance ranking was sought from the Applicant in follow-up RAI-W-SMR Test Plan and Scaling-84 (Ref.12). In response to the follow-up RAI the Applicant agreed to revise the importance ranking for phenomenon E.1 in LTR Table 3-3 to [ ]^{a,c} The response to the follow-up RAI is acceptable because it addresses the concern that was outlined in the RAI. However, the updated LTR Table 3-3 in the revised response to RAI-TR- SBLOCA-PIRT-103 did not initially show the changes proposed by the Applicant but the changes were provided later. Necessary information was provided in response to RAI-TR-SBLOCA-PIRT-103 (Ref.9 and Ref.14).

The importance ranking in the PIRT in the LTR for all the phenomena under [ ]^{a,c} in the "SG – Primary/Tube Side" (G.2.a-c in LTR Table 3-3) was questioned in RAI-TR-SBLOCA-PIRT-89. The importance ranking is [ ]^{a,c} The corresponding rationale (P47 in LTR Table 3-4) states that a [ ]^{a,c} Due to the influence on loop-wide natural circulation, the [ ]^{a,c} has been ranked as 'Medium' importance in phases 1 and 2 in the NRC/RES SBLOCA PIRT. In response to the RAI, the Applicant provided justification for the importance ranking. According to the Applicant, [ ]^{a,c}

This explanation is acceptable in explaining the difference between the rankings for Phase 2 in the NRC/RES and the Westinghouse PIRTs. However, the rationale for the importance ranking of phenomenon G.2.a-c in LTR Table 3-3 states that a [ ]^{a,c} This rationale was questioned and the Applicant was requested to clarify the basis for the importance ranking of phenomenon G.2.a-c in LTR Table 3-3 in follow-up RAI-W SMR Test Plan and Scaling-82. In response to the follow-up RAI, the Applicant agreed to modify the rationale for phenomena G.2.a-c in the LTR to reference the identifier P89. In conjunction with that change, the Applicant proposed to update the text for rationale P89 in Table 3-4 of the LTR to provide the basis for the importance ranking as explained in response to the original RAI (i.e. RAI-TR-SBLOCA-PIRT-89). The resulting changes shown in the revised response to RAI-TR-SBLOCA-PIRT-103 are acceptable because they resolve the issue that was raised in the follow-on RAI. It should be noted that the identifier P89 was previously changed to "Not used" in response RAI-TR-SBLOCA-PIRT-100. The response to RAI-W SMR Test Plan and Scaling-82 will supersede the previous change.

The importance ranking of phenomena [ ][a,c] in the "SG – Secondary/Shell Side" component (H.1 in LTR Table 3-3) was questioned in RAI-TR- SBLOCA-PIRT-90 (Ref.9). Part (a) of the RAI questioned the importance rank for the [ ][a,c] phenomenon (H.1.a in LTR Table 3-3) which is assigned as [

][a,c] Therefore, the NRC/RES SBLOCA PIRT assigns a 'Low' importance ranking for all phases to the phenomenon of [ ][a,c] on the SG secondary side. In addition, the rankings for [ ][a,c] (H.1.a in LTR Table 3-3) and [ ][a,c] (H.1.d in LTR Table 3-3) are identical which also appears to be contradictory. In response to part (a) of the RAI, the Applicant agreed that [ ][a,c] and agreed to remove that phenomena (H.1.a in LTR Table 3-3). The response and the proposed change are acceptable. In part (b) of RAI-TR-SBLOCA-PIRT-90 the importance ranking for [ ][a,c] (H.1.b in LTR Table 3-3) and [ ][a,c] (H.1.c in LTR Table 3-3) was questioned. These phenomena carry an importance ranking of [ ][a,c] The corresponding rationale (P48 in LTR Table 3-3) does not provide any details.

It is unclear how the contribution of these phenomena is significant because the amount of energy transmitted via the hot leg wall to the secondary side and from the RPV wall due to stored energy release is expected to be small as compared to the fission and decay power. Due to the relative unimportance of [ ][a,c] as compared to decay heat, they are assigned a 'Low' importance rank for all accident phases in the NRC/RES SBLOCA PIRT.

In response to part (b) of RAI-TR-SBLOCA-PIRT-90, the Applicant stated that even though the [ ][a,c] are retained as these rankings are in the conservative direction. This approach and the response are acceptable.

The importance ranking for [ ][a,c] (H.3.e in Table 3-3) and [ ][a,c] (H.4 in Table 3-3) is [ ][a,c] On the basis of the analysis results presented in response to RAI-TR-SBLOCA-PIRT-4 and the phase definitions, the [ ][a,c] of the accident. The Applicant was asked to address this inconsistency in RAI-TR-SBLOCA-PIRT-91 (Ref.9) because it makes the sequence of events used to assign importance rankings in the NRC/RES and the Westinghouse PIRTs inconsistent.

In response to the RAI, the Applicant agreed to change the importance ranking and the rationale to reflect the fact that the [ ][a,c] and therefore, the phenomenon is inactive in that phase. The response is acceptable. However, the resulting changes as discussed in response to RAI-TR-SBLOCA-PIRT-103 simply alter the importance ranking for [

][a,c] In response to the follow-up RAI the Applicant agreed to change the importance ranking for the phenomena [ ][a,c] The response to the follow-up RAI is acceptable because it resolves the issue that was raised. However, the updated LTR Table 3-3 in the revised response to RAI-TR-SBLOCA-PIRT-103 does not show the changes proposed by the Applicant. Necessary information was provided in response to RAI-TR-SBLOCA-PIRT-103 (Ref.9).

Additional description for the rationale for the ranking for [ ][a,c] in the "SG – Secondary/Shell Side" component (H.3.a in LTR Table 3-3) was requested in RAI-TR-SBLOCA-PIRT-92. The rationale under P132 in LTR Table 3-4 does not provide information about how [ ][a,c] impacts the FoMs for the PIRT. The Applicant provides an explanation for the cited phenomenon and its ranking. The Applicant asserts that the [ ][a,c] The Applicant's response and the proposed changes are acceptable. Note that the phenomenon of [ ][a,c] is not explicitly present for the "SG Secondary (Shell Side)" component in the NRC/RES SBLOCA PIRT. The NRC/RES staff noted that the influence of this phenomenon is included in the ranking for "Two-phase pressure drop" and "Choked flow through SGDVs."

The [ ][a,c] in conjunction with the SBLOCA is expected to have an appreciable impact on the FoMs. However, the [ ][a,c]

[ ][a,c] The Applicant was asked to explain the reason for the exclusion of the [ ][a,c] in RAI-TR-SBLOCA-PIRT-93 (Ref.9). In response, the Applicant clarified that the [ ][a,c] In addition, based on the updated event sequence the Applicant agreed to change the importance ranking for this phenomenon to [ ][a,c] The response and the proposed change are acceptable. Note that the phenomenon of [ ][a,c] is considered explicitly in the NRC/RES SBLOCA PIRT. The phenomenon also carries a 'Medium' importance rank for Phase 2 of the accident.

There appear to be inconsistencies in the importance rankings for [ ][a,c] in the "CMT" component (L.1.c in LTR Table 3-3) and [ ][a,c] in the "PRHR HX – Tube Side (RCS)" component (M.1.c in LTR Table 3-3). The rationale for L.1.c (P63 in LTR Table 3-4) refers to [ ][a,c] If L.1.c is indeed ranked based on [ ][a,c] it is expected that the rankings for M.1.c should be the same as those for L.1.c.

However, this is not the case for [ ][a,c] The Applicant was asked to clarify the phenomena that are being considered in L.1.c and M.1.c in RAI-TR-SBLOCA- PIRT-94 (Ref.9).

In response, the Applicant [

]^{a,c} agrees to change the LTR accordingly. The response and the proposed changes are acceptable.

According to the event description for the DVI DEGB, the [ ]^{a,c} The calculated ADS-1 and ADS-2 flow rates (provided as part of the response to RAI-TR-SBLOCA-PIRT-4) appear to [

]^{a,c} The Applicant was asked to confirm this behavior in RAI-TR-SBLOCA-PIRT-95 (Ref.9). The Applicant clarified that [

]^{a,c} Therefore, the inclusion of the phenomena related to [ ]^{a,c} in the PIRT is justified. The response is acceptable since it provided the requested information.

The NRC/RES SBLOCA PIRT ranks phenomena during the [ ]^{a,c} based on independent panel's understanding of the scenario progression prior to the receipt of the response to RAI-TR-SBLOCA-PIRT-95 (Ref.9).

The Westinghouse PIRT does not distinguish between the [ ]^{a,c} The NRC/RES SBLOCA PIRT considered the [ ]^{a,c} separately. The flow (choked or otherwise) from the [ ]^{a,c} is expected to have an impact on the FoMs for the PIRT. However, this phenomenon does not appear in the LTR PIRT. The lack of consideration of the flow from the [ ]^{a,c} in the Westinghouse PIRT was questioned in RAI-TR-SBLOCA-PIRT-96. In response the Applicant clarifies that the [ ]^{a,c} is captured in the [ ]^{a,c} component (Component K in LTR Table 3-3).

The phenomena in the [ ]^{a,c} component in the LTR are consistent with those that were considered in the NRC/RES SBLOCA PIRT from the [ ]^{a,c} In addition, the importance rankings for several of these phenomena in the LTR are higher than the rankings of similar phenomena in the NRC/RES SBLOCA PIRT. As a result, the response to the RAI is acceptable.

The PIRT in the LTR does not distinguish between the [ ]^{a,c} The NRC/RES SBLOCA PIRT considered the [ ]^{a,c} separately. Confirmation was sought from the Applicant in RAI-TR-SBLOCA- PIRT-97 (Ref.9) that the rankings for the phenomena in the [ ]^{a,c} component (S in LTR Table 3-3) are equally applicable to the [ ]^{a,c} The response appears to confirm that the [

]^{a,c} The phenomena in the [ ]^{a,c} component (S in LTR Table 3-3) are consistent with those that were considered in the NRC/RES SBLOCA PIRT for the [ ]^{a,c} According to the Applicant, the phenomenon of [ ]^{a,c} considered for [ ]^{a,c} is ranked collectively in the [ ]^{a,c} (Component K in LTR Table 3-3). In addition, the importance rankings for these phenomena in the LTR are higher than or same as the rankings of similar phenomena in the NRC/RES SBLOCA PIRT. As a result, the response to the RAI is acceptable.

RAI-TR-SBLOCA-PIRT-98 (Ref.9) questioned the importance rankings for some of the phenomena under [ ]a,c in the "CMT Balance Line" component (S.1 in LTR Table 3-3). Based on the phenomena definitions and the rationale provided for [ ]a,c (S.1.b in LTR Table 3-3) and [ ]a,c (S.1.g in LTR Table 3-2), it appears that S.1.b accounts for S.1.g. The [

]a,c The Applicant was asked to explain the influence of the [ ]a,c that is being ranked in phenomena S.1.g and is not captured in S.1.b in part (a) of RAI-TR-SBLOCA-PIRT-98. In response to part (a) of the RAI the Applicant agreed that [ ]a,c The Applicant further agreed [ ]a,c The rationale in the LTR (P121 in LTR Table 3-4) for the importance rankings for [ ]a,c (S.1.c in LTR Table 3-3) mentions the phases during the accident when [ ]a,c is present in the CMT. However, the reason for the rankings is missing. As a result, it is difficult to determine what exactly is being ranked and how phenomenon S.1.c differs from phenomena S.1.b and S.1.g in LTR Table 3-3. The NRC/RES SBLOCA PIRT does not consider the phenomenon of [ ]a,c separately as the phenomenon of [ ]a,c is expected to capture the resulting influence. The Applicant was asked to expand the rationale for the importance ranking for S.1.c in LTR Table 3-3 in part (b) of RAI-TR-SBLOCA-PIRT-98. In addition, there appears to be an inconsistency in the importance rankings for [ ]a,c (S.1.b in LTR Table 3-3) and [ ]a,c (S.1.c in LTR Table 3-3) in Phase 4. It is unclear how [ ]a,c The Applicant was asked to address this inconsistency in part (c) of the RAI-TR-SBLOCA-PIRT-98. In response to part (b) of the RAI the Applicant agreed to expand the rationale (P121 in LTR Table 3-4).

In addition, the Applicant agreed to change the ranking for phenomenon S.1.c in LTR Table 3-3 to [ ]a,c which addresses part (c) of the RAI. The change in the ranking of [ ]a,c (S.1.c in LTR Table 3-3) to [ ]a,c makes the rankings of that phenomenon the same as those for [ ]a,c (S.1.b in LTR Table 3-3) for all phases. Therefore, the approach in the NRC/RES SBLOCA PIRT of ranking only the [ ]a,c is valid. The response to RAI-TR-SBLOCA-PIRT-98 and the proposed changes to the LTR are acceptable.

The rationale for the importance ranking for the phenomenon [ ]a,c in the "ICP" component (T.1.e in LTR Table 3-3) raises the possibility of [ ]a,c (P83 in Table 3-4).

The importance rank of [ ]a,c for the phenomenon as well as the corresponding [ ]a,c knowledge rank was questioned in RAI-TR-SBLOCA-PIRT-99. The questions were based on the presumption that the phenomenon refers to the piping connecting adjacent ICPs. This presumption was also used in the ranking for the same phenomenon in the NRC/RES SBLOCA PIRT resulting in a 'Low' importance and knowledge ranking. In response, the Applicant clarifies that that the phenomenon ranked in item T.1.e of LTR Table 3-3 is related to the [

]^{a,c} The clarification and justification provided by the Applicant are acceptable. The clarification explains the difference in the rankings between the NRC/RES and the Westinghouse PIRTs for the [ ]^{a,c} phenomenon. The discrepancy in the rankings arises due to different interpretation of the phenomenon. It should be noted that the importance ranking in the Westinghouse PIRT is higher than that in the NRC/RES PIRT and is therefore, conservative. However, the definition for the [ ]^{a,c} phenomenon (D37 in LTR Table 3-2) is unclear and does not contain the clarification provided in response to the RAI. A follow-up RAI, RAI-W SMR Test Plan and Scaling-83, recommended that the definition in the LTR be clarified. Such clarification would also help in identifying the difference between the NRC/RES and Westinghouse PIRT rankings for [ ]^{a,c} In response to the follow-up RAI, the Applicant agreed to change the identifier for the phenomenon of [ ]^{a,c} in LTR Table 3-2 to D58. In conjunction with this change, the Applicant also proposed to update the description for D58 to clarify the phenomenon as explained in the response to the original RAI (i.e. RAI-TR-SBLOCA-PIRT-99 (Ref.9). The resulting changes shown in the revised response to RAI-TR-SBLOCA-PIRT-103 are acceptable because they resolve the issue that was raised in the follow-on RAI. It should be noted that the identifier D58 was previously changed to "Not used" in response RAI-TR-SBLOCA-PIRT-79. The response to RAI-W SMR Test Plan and Scaling-83 will supersede the previous change.

The importance ranking rationale described in P89 in LTR Table 3-4 is not used anywhere in LTR Table 3-3. RAI-TR-SBLOCA-PIRT-100 (Ref.9) requested the Applicant to confirm and if necessary, delete the rationale from the LTR. In response the Applicant agreed to remove rationale in P89 from LTR Table 3-4 because it is not used anywhere in LTR Table 3-3.

The resulting change as shown in response to RAI-TR-SBLOCA- PIRT-103 indicates that P89 is not actually deleted from LTR Table 3-4 but is marked as "Not Used". This approach is also acceptable, even though it is inconsistent with the response to RAI-TR-SBLOCA-PIRT-100. A follow-up RAI was not formulated since the issue raised in the RAI has been resolved. However, in response to RAI-W SMR Test Plan and Scaling-82 (Ref.12) that was issued subsequent to RAI-TR-SBLOCA-PIRT-100, the Applicant will use P89, with modification to its text, to provide the rationale for phenomena G.2.a-c in Table 3-3 of the LTR. That change supersedes the response to RAI-TR-SBLOCA-PIRT-100.

RAI-TR-SBLOCA-PIRT-101 requested details of the logic that would be employed by the Applicant in selecting the bounding values for sensitivities that seek to characterize the effect of [ ]^{a,c} The obvious bounding value for [ ]^{a,c} It was unclear, based on the review of the LTR, how any other value could be justified. In response to RAI-TR-SBLOCA-PIRT-101 (Ref.9) the Applicant has qualitatively explained that the [ ]^{a,c}

The intent of the explanation appears to be to discuss the approach that can be used to justify the selected limiting values. According to the Applicant, the [

]a,c Even though the explanation by the Applicant appears to be plausible, it cannot be verified due to the qualitative nature of the response, and lack of any supporting analyses. It is not clear that the [

]a,c can be convincingly quantified "using engineering principles" as stated by the Applicant. However, requesting and reviewing the calculations that follow the Applicant's approach is beyond the scope of this report. As a result, the response is acceptable since the Applicant has explained how it intends to justify bounding assumptions. The Applicant is requested to submit the results of all code calculations and any available test results showing [
]a,c Similarly, the Applicant is also requested to submit the rationale and calculations performed in support of bounding assumptions used in computer simulations to demonstrate the [ ]a,c

Tables 4-1 and 4-2 in Section 4, "Summary and Conclusions," of the LTR include specific recommendations for testing that make references to a [

]a,c

The Applicant has provided WCAP-17712, "Westinghouse SMR Test Plan" (Ref.10), which also contains functional requirements for both the IETs and SETs. It is noted that the review of the test plan including the test facility scaling and test matrix is not within the scope of this review. RAI-TR-SBLOCA-PIRT-102 requested clarification of the Applicant's intent of providing the information in the testing rationale columns in Tables 4-1 and 4-2 in the LTR and is therefore, out of scope of the present LTR review.

RAI-TR-SBLOCA-PIRT-103 requested the Applicant to provide a table summarizing the changes to the WCAP-17573-P due to the responses to RAI-TR-SBLOCA-PIRT-69 through -102. In response the Applicant provided Table 103-1 which summarizes the changes to WCAP-17573-P that were discussed in response to RAI-TR-SBLOCA-PIRT-69 through -102. In addition, related pages of the LTR are included in Table 103-1 with the corresponding updates. It is noted that the content of Table 103-1 is reviewed in conjunction with each individual RAI from RAI-TR-SBLOCA-PIRT-69 through -102.

The Applicant updated the response to RAI-TR-SBLOCA-PIRT-103 to capture the changes due to the response to RAI-W SMR Test Plan and Scaling-79 through -84. The changes are found to be acceptable. Table-1 of this SER lists the changes to the LTR that the Applicant has committed to undertake. Necessary information was provided in response to RAI-TR-SBLOCA-PIRT-103 (Ref.9).

4 SUMMARY AND CONCLUSIONS

A review of the SBLOCA PIRT for the W-SMR and relevant information as documented in the LTR (Ref.1) submitted by the Applicant has been performed. This included a review and evaluation of responses to a large number of RAIs that were submitted by the Applicant to the NRC as part of the review process. This review was performed subsequent to the development of an independent SBLOCA PIRT for the W-SMR by a panel under the auspices of NRC/RES. The NRC/RES SBLOCA PIRT also formed the basis for several RAIs questioning specific aspects of the importance and knowledge rankings associated with the SBLOCA PIRT as reviewed in this SER.

4.1 Conditions and Limitations

Based on the evaluation of the LTR that is documented in this SER, the following conditions and/or limitations have been identified by the NRC:

1. The SBLOCA PIRT and the resulting conclusions documented in the LTR are to be restricted to the W-SMR design as currently described in Sections 1.1 and 1.2 of the LTR (including the changes to the LTR that have been committed to by the Applicant). The Applicant is to submit, for review and further evaluation by the NRC, any changes to the W-SMR design as compared to that documented in Sections 1.1 and 1.2 of the LTR, including the impact of any changes in the design on the SBLOCA PIRT and the corresponding LTR conclusions.

2. The SBLOCA PIRT submitted with the LTR (Ref.1) is to be confirmed by the applicant through a combination of code sensitivity/uncertainty studies and analysis of experimental data gathered during the planned test program. These confirmation studies will highlight the most important processes/phenomena. Based on past experience, these studies can change the number of highly ranked phenomena in the PIRTs.

   Furthermore, it is desirable to perform these confirmatory studies once the relevant test data is available and the evaluation model has been approved by the NRC for use in W-SMR licensing applications.

   The Applicant is to submit for review any changes to the SBLOCA PIRT and the LTR as a consequence of PIRT confirmation studies performed using a combination of code sensitivity and/or uncertainty analyses, results of planned SETs and IETs, and any other experimental data that will be utilized for the purpose of any future safety assessment studies and design certification submittals to the NRC.

3. The Applicant is to make available for audit the test data related to ADS-2 liquid entrainment, the incorporation of the entrainment data and corresponding correlation in the SBLOCA evaluation model (WCOBRA-TRAC TF2) and the code SKBOR (used for boron concentration calculations) for review by the NRC during the design certification submittals. (RAI-TR-SBLOCA-PIRT-RAI-60).

4. The Applicant is to make available for audit the code calculations and any available test results showing sensitivity of the system behavior to form losses in the "trash rack" and

sump screen. Similarly, the Applicant is to make available for audit the rationale and the calculations performed in support of any bounding assumptions used in computer simulations to demonstrate the effect of debris blockage in a line on the key FoMs. (RAI-TR-SBLOCA-PIRT-RAI-17 and 101).

5. The LTR (Ref.1) is to be revised to include all commitments by the Applicant in its response to several NRC RAIs. The list of changes that the Applicant has committed to is provided in the response to RAI-TR-SBLOCA-PIRT-103 and is also included in Table 1 of this report.

6. The use of the SBLOCA PIRT and the resulting conclusions documented in the LTR (Ref.1) are restricted to the following objectives listed by the Applicant in the LTR (Ref.1):

   (a) To determine the requirements for an adequate evaluation model to perform the safety analyses (SBLOCA) for the W-SMR, and

   (b) To develop a test matrix of SETs and IETs intended to provide an adequate evaluation model assessment database for application to the W-SMR.

7. The review of the test plan including the test facility scaling and test matrix is not within the scope of this review. RAI-TR-SBLOCA-PIRT-102 requested clarification of the Applicant's intent of providing the information in the testing rationale columns in Tables 4-1 and 4-2 in the LTR and is therefore, out of scope of the present LTR review.

8. The review of the LTR focused solely on the SBLOCA PIRT. Therefore, the conclusions on the LTR listed above do not extend to the testing recommendations contained in Section 4. The review of the test plan, including the test facility scaling and test matrix, which is required to determine the acceptability of the proposed testing rationale as they relate to the EMDAP is not within the scope of the current review.

4.2 Conclusions

Based on the present review of the LTR, the following general conclusions are in order:

- The Westinghouse PIRT development process has followed the EMDAP guidance as outlined in Regulatory Guide 1.203.

- The LTR documents a PIRT for SBLOCAs which is supported by sufficient rationale and justification for the assigned importance and knowledge rankings.

- This review finds that once the LTR is modified by the Applicant in the response to various RAIs, the PIRT would be acceptable subject to conditions and limitations given above for use to support EMDAP for the planned application by Westinghouse to the W-SMR design as part of the design certification process.

- When Westinghouse submits the DCA for the W SMR, the W-SMR PIRT evaluation will support the evaluation of the W-SMR test programs and safety analysis methodologies in accordance with Standard Review Plan (SRP) 15.0.2, "Review of Transient and Accident Analysis Method."

The staff finds the LTR (Ref.1) acceptable subject to conditions and limitations given above for referencing in licensing actions.

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5. REFERENCES

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2. 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," 68 Federal Register 54142, September 16, 2003.

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5. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information (SBLOCA PIRT)," SMR_NRC_000010, June 17, 2013 (ML13192A459), Pkg number ML131920503.

6. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information (SBLOCA PIRT)," SMR_NRC_000014, July 19, 2013 (ML13205A334), (ML13205A330).

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9. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information (SBLOCA PIRT)," SMR_NRC_000028, November 26, 2013 (ML13339A628), Pkg number ML13339A627.

10. "Westinghouse SMR Test Plan," Westinghouse Electric Company, LLC, WCAP-17712-P, Revision 0, January 2013 (ML13050A679), (ML13050A684).

11. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information (SBLOCA PIRT)," SMR_NRC_000034, February 14, 2014 (ML14051A702).

12. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information (SBLOCA PIRT)," SMR_NRC_000035, March 4, 2014 (ML14066A129).

13. Audit Report Summary associated with the W SMR SBLOCA PIRT Table Topical Report, January 28, 2014 (ML14028A205).

14. R. Sisk (Westinghouse) to the NRC Document Control Desk, "SMR Response to Request for Additional Information," SMR_NRC_000038, May 13, 2014 (ML14135A322).

6. TABLE 1, INDEX OF CHANGES TO LTR RESULTING FROM RAI RESPONSES.

(Note: This table lists the changes to the LTR that the Applicant committed to make as part of the responses to the listed RAIs.)

TABLE 1 - INDEX OF CHANGES TO LTR RESULTING FROM RAI RESPONSES a,c

a,c

a,c

a,c
