

# Holtec SMR - TMI Requirements



Date: 10/04/2023

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# Agenda

- Introductions
- Purpose & Outcome
- Discussion of TMI requirements
- Questions
- Open Forum

# Purpose & Outcome

## Purpose

- Provide SMR's plan to address TMI requirements (10 CFR 50.34(f))

## Outcome

- Obtain feedback from NRC staff on this approach

# Format – Reflects the Planned SAR Table



Item	Requirement	Conformance	Justification
(f)(#)(#)	The requirement is...	Conforms <i>or</i> N/A <i>or</i> Exemption	As included in conformance table in PSAR.

Notes/Comments/Questions: These will not be included in the final table.

Some items that are “Applicable to BWRs or B&W Only” are moved to the end of the presentation.

# General Question: Conformance Table Format

## ■ 50.34(f)(1) requires:

“sufficient information to describe the nature of the studies, how they are to be conducted, estimated submittal dates, and a program to ensure that the results of these studies are factored into the final design of the facility”

✓ (f)(2) and (f)(3) have similar statements on “sufficient information”

## ■ In some cases, SMR may not include this level of detail in the conformance table for the sake of clarity/brevity

✓ Additional detail will be available elsewhere in the SAR – is a reference for each TMI requirement necessary?

# PRA - Conforms



Item	Requirement	Conformance	Justification
(f)(1)(i)	Perform a plant/site specific PRA.	Conforms	A plant/site-specific PRA has been developed that has been integrated into the design process. PRA will be updated and submitted as part of the OLA.

# Aux Feedwater – N/A



Item	Requirement	Conformance	Justification
(f)(1)(ii)	Perform an evaluation of the proposed auxiliary feedwater system (AFWS)...	N/A	The Holtec SMR design does not include an AFWS.

Note: The PCC (SDH) has a similar safety-related DHR function to AFWS. SMR has completed appropriate analyses and reviews to ensure its reliability. SMR does not intend to include discussion about the PCC in this requirement.

# RCP Seal Damage – Pending



Item	Requirement	Conformance	Justification
(f)(1)(iii)	Perform an evaluation of RCP seal damage following small-break LOCA...	Pending	SMR is evaluating a variety of RCP designs. Some designs under consideration are seal-less, in which case this requirement would not be applicable.

Question: In the event that a seal-less design is selected, should this requirement be considered N/A or should SMR pursue an exemption?



# Stuck-open PORV – N/A



Item	Requirement	Conformance	Justification
(f)(1)(iv)	Perform an analysis of the probability of a small-break LOCA caused by a stuck-open PORV...	N/A	The Holtec SMR design does not include PORVs in the RCS.

Note: The Holtec SMR design uses spring-loaded, self-actuated safety valves for overpressure protection. The ADS valves are power-operated but are intended to remain open after initial operation during a LOCA. SMR does not intend to include discussion of those valves in this portion.

# Automatic Depressurization – N/A

Item	Requirement	Conformance	Justification
(f)(1)(vii)	Perform a feasibility and risk assessment study to determine the optimum automatic depressurization system (ADS) design modifications that would eliminate the need for manual activation to ensure adequate core cooling.	N/A  (Conforms)	Applicable to BWR's only.  (The Holtec SMR design also includes an ADS similar to that used by BWRs. ADS automatically actuates on low RCS level.)

Question: SMR intends to list this as N/A as the regulation stipulates it is applicable to BWRs only. Should this be listed as conforms instead?

# ADS Operation Following an Accident – N/A



Item	Requirement	Conformance	Justification
(f)(1)(x)	Perform a study to ensure that the Automatic Depressurization System, valves, accumulators, and associated equipment and instrumentation will be capable of performing their intended functions during and following an accident situation...	N/A  (Conforms)	Applicable to BWR's only.  (The Holtec SMR design includes an ADS similar to that used by BWRs. ADS valves are powered by safety-related DC power sources.)

Question: SMR intends to list this as N/A as the regulation stipulates it is applicable to BWRs only. Should this be listed as conforms instead?

# Simulator Capability – Conforms



Item	Requirement	Conformance	Justification
(f)(2)(i)	Provide simulator capability that correctly models the control room and includes the capability to simulate small-break LOCA's.	Conforms	Simulator development is underway and expected to be declared a plant-reference simulator prior to submittal of the OLA.

# Continuous Improvement - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(ii)	Establish a program, to begin during construction and follow into operation, for integrating and expanding current efforts to improve plant procedures...	Conforms	Programs have been established to improve plant procedures. Programs include and incorporate emergency procedures, reliability analyses, human factors engineering, crisis management, operator training, and coordination with INPO and other industry efforts.

# Control Room Human Factors - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(iii)	Provide, for Commission review, a control room design that reflects state-of-the-art human factor principles...	Conforms	The Holtec SMR control room design incorporates state-of-the-art human factor engineering principles.



# Plant Safety Parameters Display - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(iv)	Provide a plant safety parameter display console that will display to operators a minimum set of parameters defining the safety status of the plant...	Conforms	The Holtec SMR main control room design includes a safety-visual display unit that provides plant parameters that define the safety of the plant in addition to other important parameters and data trends.

# Safety System Indications - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(v)	Provide for automatic indication of the bypassed and operable status of safety systems.	Conforms	The Holtec SMR safety-visual display unit design provides automatic indication of the bypassed and operable status of safety systems.



# High Point Venting - Conforms

Item	Requirement	Conformance	Justification
(f)(2)(vi)	Provide the capability of high point venting of noncondensable gases from the reactor coolant system, and other systems that may be required to maintain adequate core cooling...	Conforms	The SMR-160 design contains non-safety-related HPVs, used during RCS drain and fill operations during refueling outages, but not to ensure core cooling. Non-condensable gases will not ingress to the RCS in any significant amount other than from the Accumulators, which only actuate during LOCAs. The ADS system sufficiently removes non-condensable gases during these events to ensure adequate long-term cooling. The only source of non-condensable gases during non-LOCAs is from radiolysis, but it is not significant enough to challenge core cooling.

Question: The SMR-160 design contains high point vents, but the intent of the requirement is instead fulfilled by the ADS valves. SMR intends to state that the design conforms with the requirement. Is an exemption more appropriate?

# Radiation and Shielding Reviews - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(vii)	Perform radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain accident source term radioactive materials...	Conforms	The Holtec SMR is designed to protect vital areas, as defined by NUREG-0737, Item II.B.2, from the radiation environment resulting from an accident. Safety-related equipment is environmentally qualified to ensure adequate protection from the radiation environment resulting from an accident.

# Post Accident Sampling - Exemption



Item	Requirement	Conformance	Justification
(f)(2)(viii)	Provide a capability to promptly obtain and analyze samples from the reactor coolant system and containment that may contain accident source term radioactive materials...	Exemption	The Holtec SMR design enables assessment of core damage through means other than obtaining and analyzing samples from the reactor coolant system and containment.

Note: SMR is evaluating whether to include instruments for sampling hydrogen in the containment atmosphere. The requirements of 50.34(f)(2)(xvii) and 50.44(c)(4)(ii) to include equipment for hydrogen monitoring are being considered.

# Hydrogen Control – Conforms

Item	Requirement	Conformance	Justification
(f)(2)(ix)	Provide a system for hydrogen control that can safely accommodate hydrogen generated by the equivalent of a 100% fuel-clad metal water reaction...	Conforms	The Holtec SMR design includes passive autocatalytic recombiners (PARs) in the containment to accommodate a 100% fuel clad metal-water reaction. Effects of the 100% clad metal-water reaction have been evaluated for containment integrity and environmental qualification.
(f)(1)(xii)	Perform an evaluation of alternative hydrogen control systems that would satisfy the requirements of paragraph (f)(2)(ix) of this section...		

# Relief and Safety Valve Testing - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(x)	Provide a test program and model development to qualify relief and safety valves...	Conforms	The Holtec SMR design conforms to this requirement other than the aspects related to PORVs and ATWS conditions. The Holtec SMR design does not utilize PORVs. Additionally, ATWS conditions need not be considered given the Holtec SMR design supports an exemption from 10 CFR 50.62(c)(1) given the intent to have a diverse scram system is met, and therefore the response to an ATWS is not analyzed in Section 15.8.



# Valve Position Indication - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xi)	Provide direct indication of relief and safety valve position (open or closed) in the control room. (II.D.3)	Conforms	The Holtec SMR design provides direct indication of relief and safety valve position (open or closed) in the MCR.

# AFW Initiation and Indication – N/A

Item	Requirement	Conformance	Justification
(f)(2)(xii)	Provide automatic and manual auxiliary feedwater (AFW) system initiation, and provide auxiliary feedwater system flow indication in the control room.	N/A	The Holtec SMR design does not include an AFW system.

Note: The PCC (SDH) has a similar safety-related DHR function to AFWS. The PCC is provided with automatic and manual system initiation and is a fully passive system that does not rely on specific minimum flow rates enabled by pumps. Therefore, flow indication is not necessary to demonstrate successful operation of the PCC.

# PZR Heaters/Natural Circulation – Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xiii)	Provide pressurizer heater power supply and associated motive and control power interfaces sufficient to establish and maintain natural circulation in hot standby conditions with only onsite power available.	Conforms	The Holtec SMR design does not rely on pressurizer heaters to maintain natural circulation. In the event of a LOOP, decay heat removal can be accomplished by the passive primary decay heat removal (PDH) and secondary decay heat removal (SDH) heat exchangers. Activation of the PHR and SHR systems relies only on safety-related DC power.

Question: The Holtec SMR design can power its pressurizer heaters from diesel generators (not safety related) during a LOOP. If the diesel generators are not available, safety related systems are capable of maintaining core cooling. Should SMR list this as “Conform” or “Exemption”?



# Containment Isolation Systems – Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xiv)	Provide containment isolation systems that: (A) – (E)...	Conforms	The Holtec SMR design includes containment isolation functionality that conforms to all requirements in 10 CFR 50.34(f)(2)(xiv).

# Containment Purging/Venting – Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xv)	<p>Provide a capability for containment purging/venting designed to minimize the purging time consistent with ALARA principles for occupational exposure. Provide and demonstrate high assurance that the purge system will reliably isolate under accident conditions.</p>	<p>Conforms</p>	<p>The Holtec SMR design includes a containment purge system and a vacuum relief system that meet this requirement.</p>

# Instrumentation with Control Room Readouts - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xvii)	Provide instrumentation to measure, record and readout in the control room: (A)-(E)... Provide for continuous sampling of radioactive iodines and particulates in gaseous effluents...	Conforms	The Holtec SMR design includes containment instrumentation that conforms to all requirements in 10 CFR 50.34(f)(2)(xvii).

Note: SMR is evaluating whether to include instruments for sampling hydrogen in the containment atmosphere, which would require an exemption to part (C) of this requirement. The requirement of 50.44(c)(4)(ii) to include equipment for hydrogen monitoring is also being considered.

# Instrumentation for Core Cooling Indication - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xviii)	Provide instruments that provide in the control room an unambiguous indication of inadequate core cooling, and a suitable combination of signals from indicators of coolant level in the reactor vessel and in-core thermocouples...	Conforms	The Holtec SMR design uses reactor vessel level indication, core exit thermocouples, and RCS pressure indication to provide unambiguous indication of inadequate core cooling.

# Instrumentation for Monitoring after Core Damage - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xix)	Provide instrumentation adequate for monitoring plant conditions following an accident that includes core damage.	Conforms	The Holtec SMR design adheres to the guidance of RG 1.97 and IEEE-497 for instrumentation for monitoring plant conditions following an accident that includes core damage.

# PZR Valve and Indicator Power - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xx)	Provide power supplies for pressurizer relief valves, block valves, and level indicators such that: (A)-(C)...	Conforms	The Holtec SMR design conforms to this requirement other than the aspects related to PORVs since the Holtec SMR design does not use PORVs. Pressurizer level instrumentation is powered by Class 1E DC power distribution system.



# Support Facilities - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xxv)	Provide an onsite Technical Support Center, an onsite Operational Support Center, and, for construction permit applications only, a nearsite Emergency Operations Facility.	Conforms	The Holtec SMR design includes an onsite Technical Support Center, an onsite Operational Support Center, and a nearsite Emergency Operations Facility.

# Leakage Control/Detection – N/A

Item	Requirement	Conformance	Justification
(f)(2)(xxvi)	Provide for leakage control and detection in the design of systems outside containment that contain (or might contain) accident source term radioactive materials following an accident...	N/A	The Holtec SMR is designed such that the safety-related PCC does not circulate radioactive fluids outside containment following an accident. Non-safety-related systems could be used to recirculate coolant outside of containment during an accident, but the system will not be allowed to operate if high containment radiation levels exist.



# In-Plant Radiation Monitoring - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xxvii)	Provide for monitoring of in-plant radiation and airborne radioactivity as appropriate for a broad range of routine and accident conditions.	Conforms	The Holtec SMR design includes in-plant radiation and airborne radioactivity detection.

# Control Room Habitability - Conforms



Item	Requirement	Conformance	Justification
(f)(2)(xxviii)	Evaluate potential pathways for radioactivity and radiation that may lead to control room habitability problems under accident conditions resulting in an accident source term release, and make necessary design provisions to preclude such problems.	Conforms	SMR has evaluated the potential impacts of radioactivity and radiation on MCR habitability, and the Holtec SMR design includes the MCHS to preclude habitability problems.

# Industry Lessons Learned - Conforms



Item	Requirement	Conformance	Justification
(f)(3)(i)	Provide administrative procedures for evaluating operating, design and construction experience and for ensuring that applicable important industry experiences will be provided in a timely manner to those designing and constructing the plant.	Conforms	The Holtec SMR design team continually incorporates operating, design, and construction experience.

# Quality Assurance List - Conforms



Item	Requirement	Conformance	Justification
(f)(3)(ii)	Ensure that the quality assurance (QA) list required by Criterion II, app. B, 10 CFR part 50 includes all structures, systems, and components important to safety.	Conforms	The Holtec SMR QAPD is discussed further in Chapter 17.

# Quality Assurance Program - Conforms



Item	Requirement	Conformance	Justification
(f)(3)(iii)	Establish a quality assurance (QA) program based on consideration of: (A)-(H)...	Conforms	The Holtec SMR QAPD is discussed further in Chapter 17.

# Containment Penetrations - Exemption



Item	Requirement	Conformance	Justification
(f)(3)(iv)	Provide one or more dedicated containment penetrations, equivalent in size to a single 3-foot diameter opening, in order not to preclude future installation of systems to prevent containment failure, such as a filtered vented containment system.	Exemption	The Holtec SMR design supports an exemption to 10 CFR 50.34(f)(3)(iv). The Holtec SMR containment is designed to accommodate peak containment pressure for design basis events.

Question: Can NRC staff elaborate on the intent of this requirement? SMR believes that the Holtec SMR design precludes the need for such a penetration.

# Preliminary Design Information: Containment Integrity - Conforms



Item	Requirement	Conformance	Justification
(f)(3)(v)	Provide preliminary design information at a level of detail consistent with that normally required at the construction permit stage of review sufficient to demonstrate that: (A)... (B)...	Conforms	The Holtec SMR design ensures containment integrity during accidents. The Holtec SMR design does not include a post-accident inerting system.



# External Hydrogen Recombiners – N/A



Item	Requirement	Conformance	Justification
(f)(3)(vi)	For plant designs with external hydrogen recombiners, provide redundant dedicated containment penetrations so that, assuming a single failure, the recombiner systems can be connected to the containment atmosphere.	N/A	The Holtec SMR design does not include hydrogen recombiners external to the containment.



# Management Plan - Conforms



Item	Requirement	Conformance	Justification
(f)(3)(vii)	Provide a description of the management plan for design and construction activities, to include: (A)-(E)...	Conforms	The Holtec SMR management plan for design and construction activities is discussed in Chapter 1.

# **N/A – BWR-specific or B&W-specific**

Question: For requirements applicable to B&W designs only, is it correct to assume that the requirements don't apply to the Holtec SMR design? Is an evaluation of applicability necessary?

# HPCI and RCIC – N/A



Item	Requirement	Conformance	Justification
(f)(1)(v)	Perform an evaluation of the safety effectiveness of providing for separation of high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) system initiation levels...	N/A	Applicable to BWRs only.

# Relief Valve Modifications – N/A



Item	Requirement	Conformance	Justification
(f)(1)(vi)	Perform a study to identify practicable system modifications that would reduce challenges and failures of relief valves, without compromising the performance of the valves or other systems.	N/A	Applicable to BWRs only.

# Core Spray and Low P Coolant Injection – N/A



Item	Requirement	Conformance	Justification
(f)(1)(viii)	Perform a study of the effect on all core-cooling modes under accident conditions of designing the core spray and low pressure coolant injection systems...	N/A	Applicable to BWRs only.

# Long-term RCIC and HPCI Operation – N/A



Item	Requirement	Conformance	Justification
(f)(1)(ix)	Perform a study to determine the need for additional space cooling to ensure reliable long-term operation of the reactor core isolation cooling (RCIC) and high-pressure coolant injection (HPCI) systems...	N/A	Applicable to BWRs only.



# Vessel Integrity During Rapid Cooldown – N/A



Item	Requirement	Conformance	Justification
(f)(1)(xi)	Provide an evaluation of depressurization methods, other than by full actuation of the automatic depressurization system, that would reduce the possibility of exceeding vessel integrity limits during rapid cooldown.	N/A	Applicable to BWRs only.

# ECSS Actuation and Overcooling – N/A



Item	Requirement	Conformance	Justification
(f)(2)(xvi)	<p>Establish a design criterion for the allowable number of actuation cycles of the emergency core cooling system and reactor protection system consistent with the expected occurrence rates of severe overcooling events (considering both anticipated transients and accidents).</p>	N/A	Applicable to B&W designs only.

# Aux Heat Removal Systems – N/A

Item	Requirement	Conformance	Justification
(f)(2)(xxi)	Design auxiliary heat removal systems such that necessary automatic and manual actions can be taken to ensure proper functioning when the main feedwater system is not operable.	N/A	Applicable to BWRs only.

# Integrated Control System Analysis – N/A



Item	Requirement	Conformance	Justification
(f)(2)(xxii)	Perform a failure modes and effects analysis of the integrated control system (ICS) to include consideration of failures and effects of input and output signals to the ICS.	N/A	Applicable to B&W-designed plants only.

# Anticipatory Reactor Trip – N/A

Item	Requirement	Conformance	Justification
(f)(2)(xxiii)	Provide, as part of the reactor protection system, an anticipatory reactor trip that would be actuated on loss of main feedwater and on turbine trip.	N/A	Applicable to B&W-designed plants only.

# Reactor Vessel Water Level – N/A



Item	Requirement	Conformance	Justification
(f)(2)(xxiv)	Provide the capability to record reactor vessel water level in one location on recorders that meet normal post-accident recording requirements.	N/A	Applicable to BWRs only.



# Open Forum

