

May 27, 2016

MEMORANDUM TO: Timothy J. McGinty, Director  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

FROM: Eric R. Oesterle, Acting Chief */RA/*  
Reactor Systems Branch  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

SUBJECT: GAS MANAGEMENT ACTION PLAN UPDATE

The enclosure to this memorandum contains a version of the gas management action plan that can be publically released, prepared in accordance with the requirements of LIC-502, which describes, schedules, and tracks the ongoing activities related to gas management.

These activities include continued collection of information during inspections, assessment of the industry's responses, participation in codes and standards activities and development of regulatory products. This action plan focuses on gas management in systems that are important to safety and the potential nuclear safety, public health and environmental effects of gas accumulation.

Enclosure:  
Office of Nuclear Reactor Regulation  
Action Plan

CONTACTS: Jennifer M. Whitman, NRR/DSS  
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Accession No.: ML16140A037

\*via email

NRR-106

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DATE	05/19/2016	05/19/2016	05/20/2016	05/27 /2016	05/20/2016

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May 2016

**NUCLEAR REACTOR REGULATION ACTION PLAN**

**GAS MANAGEMENT**

TAC NO.: ME4565  
Yellow Ticket No.: Y020100159

Last Update: April, 2015  
Lead Division: DSS  
Supporting Divisions: DPR

The Gas Management Nuclear Reactor Regulation (NRR) Action Plan consists of actions to (1) close Generic Letter (GL) 2008-01, (2) create a comprehensive gas management document, (3) address Technical Specification (TS) issues, and (4) address vortexing, gas transport, operability, and Design Basis (DB) issues that were not covered in Item 2. Items 1 and 2 have been completed. Selected schedule information is provided in the following table:

Item No.	Milestone <sup>1</sup>	Date (T=target) (C=Complete)	Lead	Support
1	<b>Close GL 2008-01</b>	07/07/11 (C)	SRXB J. Whitman	PGCB E. Bowman
	NEI gas management workshop with over 200 attendees	01/08 (C)	SRXB W. Lyon	
	Issue GL 2008-01 (GL, January 11, 2008)	01/11/08 (C)	W. Lyon	
	Receive Licensee 3-Month Responses	04/11/08 (C)	DORL PM	
	Review 3-Month Responses	08/11/08 (C)	W. Lyon	
	Receive Licensee 9-Month Responses	11/11/08 (C)	DORL PM	
	Industry meeting at Westinghouse offices	12/05/08 (C)	SRXB D. Woodyatt W. Lyon	
	Industry meeting at Westinghouse offices	01/30/09 (C)	D. Woodyatt W. Lyon	
	NEI workshop at Dana Point, CA	02/09-02/09 (C)	D. Woodyatt W. Lyon	
	Industry meeting at NEI	03/19/09 (C)	D. Woodyatt W. Lyon	
	Issue Assessment Guidance to Industry (Ruland, May 28, 2009)	05/28/09 (C)	W. Lyon	
	Issue Temporary Instruction (TI) 2515/177 (NRC, June 9, 2009)	06/09/09 (C)	W. Lyon	DIRS/IRIB S. Vaughn
	NEI / Industry / NRC meeting	01/06/10 (C)	W. Lyon	
	Workshop	01/21/10 (C)	W. Lyon	

<sup>1</sup> The list of meetings is incomplete and is provided to illustrate continued Nuclear Energy Institute (NEI) / industry / NRC interactions in support of gas-related issues.

ENCLOSURE

Item No.	Milestone <sup>1</sup>	Date (T=target) (C=Complete)	Lead	Support
	Industry meeting at NEI	06/02/10 (C)	W. Lyon	
	Complete Initial GL 2008-01 Response Reviews, Provide Requests for Additional Information (RAIs)	12/30/10 (C)	J. Whitman	
	Receive RAI Responses	05/17/11 (C)	DORL PM	
	TI 2515/177 Inspection Guidance to Regions (NRC, May 23, 2011)	05/25/11 (C)	W. Lyon	
	Complete GL Response Reviews	06/09/11 (C)	J. Whitman	
	Send Individual Closure Memos to Licensees	06/30/11 (C)	DORL PM	
	Complete GL Closure Memo (Uises, July 5, 2011)	07/05/11 (C)	J. Whitman	
2	<b>Create Comprehensive Gas Management Document</b> (See also Item 4.)	05/27/14 (C)	W. Lyon	J. Whitman
	Define Acceptable Pump Suction Void Fractions	06/30/10 (C)	W. Lyon	
	Regulatory Information Conference (RIC) session	03/11/13 (C)	J. Whitman C. Jackson W. Lyon	
	Issue Safety Evaluation Report (SER) that endorses NEI-09-10 (NRC, April, 2013)	03/19/13 (C)	J. Whitman W. Lyon	PLPB S.Stuchell
	Issue Regulatory Issue Summary (RIS) that announces endorsement of NEI 09-10 (NRC, August 23, 2013)	03/23/13 (C)	W. Lyon	S.Stuchell
	Issue Comprehensive Gas Assessment update report (Proprietary)	05/27/14 (C)	W. Lyon J. Whitman C. Jackson	
3	<b>Engage Licensees to Modify TSs to Ensure Adequate Protection</b>	Ongoing	STSB M.Hamm	
	Receive Technical Specification Task Force (TSTF) 523 Rev 0 (Schrader, June 29, 2010)	06/29/10		
	TSTF 523 Meetings with Industry <sup>2</sup>	09/30/10 (C) 01/12/11 (C)	J. Whitman	PRPB M. Honcharik
	Accept Industry TSTF for Review (Honcharik, March 2, 2011)	03/02/11 (C)	J. Whitman	M. Honcharik
	SRXB RAIs	05/10/12 (C)	W. Lyon A. Uises	

<sup>2</sup> This item provided to illustrate early TSTF-523 meetings. Later meetings are not listed.

Item No.	Milestone <sup>1</sup>	Date (T=target) (C=Complete)	Lead	Support
	Reject Proposed TSTF (Jolicoeur, May 25, 2011)	05/25/11 (C)	J. Whitman	M. Honcharik
	SE on TSTF-523 Rev 1 (NRC, December, 2012)	12/12 (C)	J. Whitman W. Lyon	M. Hamm
	TSTF-523 Rev 2 (TSTF, February 21, 2013)	02/21/13 (C)		M. Hamm
	Publish Federal Register Notice for public comment	09/02/13 (C)		M. Hamm
	Resolve any comments and issue Notice of Availability in Federal Register	12/23/13 (C)	M. Honcharik	M. Hamm
	Licensees Adopt TSTF	Ongoing		
	Pursue Generic Approach to TSTF Non-Adopters	Ongoing	W. Lyon D. Woodyatt	A. Garmoe M. Honcharik
4	<b>Gas Transport and Vortexing Issues</b>	12/31/16 (T) <sup>3</sup>	W. Lyon J. Whitman	J. Holonich
	SRXB inspection support for Millstone <sup>4</sup>	10/08 (C)	W. Lyon	
	Meeting with Industry to review Purdue Tests	07/07/09 (C)	G. Cranston D. Woodyatt W. Lyon	
	NRC Information Notice 2010-11	06/16/10 (C)	D. Garmon W. Lyon	
	Byron inspection support regarding GOTHIC	01/04/11 (C)	W. Lyon	
	Tele-conference covering planning to discuss computational methodologies	05/17/11 (C)	D. Woodyatt, W. Lyon	
	SRXB inspection support for Prairie Island	06/05/11 (C)	W. Lyon	
	NRC Information Notice 2011-17	07/26/11 (C)	J. Whitman W. Lyon	
	Initial Farley vortex assessment	05/02/12 (C)	W. Lyon	
	SRXB support for DC Cook inspection	06/03/12 (C)	W. Lyon	
	Observe aux feedwater pump test	11/12 (C)	J. Miller	W. Lyon
	SRXB support for Kewaunee inspection	01/13 (C)	J. Miller W. Lyon	
	SRXB support for Byron inspection	02/15/13 (C)	W. Lyon	
	NEI/Industry / NRC meeting to discuss vortexing	04/18/13 (C)	W. Lyon	S. Stuchell
	Prairie Island TI-177 SRXB support	07/23/14 (C)	W. Lyon	

<sup>3</sup> This date assumes planned NEI/Industry support schedule is met and is subject to change if additional SRXB inspection support is requested.

<sup>4</sup> Identification of inspection support activities is provided to illustrate continuing involvement. The list is not complete.

Item No.	Milestone <sup>1</sup>	Date (T=target) (C=Complete)	Lead	Support
	Robinson inspection support report (Lyon, September 24, 2013)	09/27/13 (C)	W. Lyon	
	SRXB support for Ft. Calhoun inspection	03/06/14 (C)	W. Lyon	
	Complete Farley vortex assessment	05/25/14 (C)	R. Nease	W. Lyon
	SRXB support for McGuire inspection	07/22/14 (C)	W. Lyon C. Jackson	
	SRXB support for N. Anna Vortex inspection	08/02/14 (C)	W. Lyon	
	NEI/ Industry /NRC meeting to discuss gas issues	08/19/14 (C)	W. Lyon	J. Holonich
	Draft NUREG that addresses gas issues	10/05/14 (C)	W. Lyon J. Whitman	
	SRXB support for Summer inspection	12/20/14 (C)	W. Lyon	
	NEI/Industry / NRC meeting to discuss gas issues	01/15/15 (C)	W. Lyon J Whitman C Jackson	
	2015 RIC Session	03/11/15 (C)	W. Lyon J Whitman C Jackson	
	SRXB Peach Bottom TSTF-523 Review	03/31/15 (C)	W. Lyon	
	SRXB Calvert Cliffs, Ginna, Nine Mile Point TSTF-523 Reviews	07/15/15 (C)	W. Lyon C. Jackson	
	SRXB Wolf Creek TSTF-523 Review	07/28/15 (C)	W. Lyon	
	NEI/Industry / NRC meeting to discuss gas issues	08/04/15 (C)	W. Lyon J Whitman C Jackson	
	NEI/Industry Topical Report. Originally anticipated 11/30/15. Therefore, delays in related work.	05/10/16 (C)	NEI, J. Riley	
	SRXB Millstone, Surry, Hatch, Oconee, McGuire, Catawba, Brunswick, Harris, Prairie Island, Farley, Vogtle, TSTF-523 Reviews	04/16 (C)	W. Lyon	
	SRXB support for Farley inspection	08/31/16 (T)	W. Lyon	
	Send NUREG to other offices for concurrence	11/30/16 (T)	W. Lyon	
	Transmit draft NUREG to NEI for proprietary review	12/16/16 (T)	E.Oesterle	
	Receive NEI proprietary review response	01/16/17 (T)	-	
	Submit NUREG to FRN for publishing	02/16/17 (T)	W. Lyon J. Whitman	J. Holonich
	Publish in FRN	N		
	Receive comments on NUREG	N+60		J. Holonich

Item No.	Milestone <sup>1</sup>	Date (T=target) (C=Complete)	Lead	Support
	Decision regarding future publications such as RG or other regulatory products	N+90	E. Oesterle	W. Lyon J. Whitman
	Address comments and modify NUREG as necessary	N+100	W. Lyon	
	Submit NUREG for final publishing	N+125	ADMIN	J. Holonich
<b>5</b>	<b>Complete Gas Management Action Plan</b>	06/31/17 (T)	W. Lyon J. Whitman D. Woodyatt	J. Holonich

**Description:**

A review of operating experience and U.S. Nuclear Regulatory Commission (NRC) inspection results showed that gas accumulation events involving systems that are important to safety have rendered or potentially rendered these risk-significant systems inoperable. The number of identified gas accumulation events and their significance at some facilities raised concerns about whether similar unrecognized design, configuration, and operability problems existed at additional facilities.

System designs vary widely regarding potential gas sources and capability to control gas. It is important that the subject systems are sufficiently filled with water to ensure that they can reliably perform their intended functions under all Loss-Of-Coolant Accident (LOCA) and non-LOCA conditions that require makeup to the Reactor Coolant System (RCS). The Final Safety Analysis Reports (FSARs) at many facilities state that some systems are full of water and TSs often require periodic surveillances to confirm this condition. Some plant TSs have incomplete Surveillance Requirements (SRs) that cover only portions of a system. The current staff position is that standard SRs are needed to ensure compliance and adequate protection to the health and safety of the public. The staff is pursuing TS changes with industry through the Technical Specification Task Force (TSTF) process.

**Regulatory Requirements:**

The regulations in Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 or similar plant-specific principal design criteria provide design requirements.<sup>5</sup> Appendix B to 10 CFR Part 50, the TSs, and licensee quality assurance programs provide operating requirements.

10 CFR 50 Appendix A requirements include the following:

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<sup>5</sup> The Atomic Energy Commission (AEC) published the rule that added 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," in the *Federal Register* (36 FR 3255) on February 20, 1971, with the rule becoming effective on May 21, 1971. Appendix A was not applied to plants with construction permits issued prior to May 21, 1971. Such plants were licensed in accord with principal design criteria that are generally similar to Appendix A requirements.

- General Design Criterion (GDC) 1 requires that the subject systems be designed, fabricated, erected, and tested to quality standards.

GDC 34 requires a Residual Heat Removal (RHR) system designed to maintain specified acceptable fuel design limits and to meet design conditions that are not exceeded if a single failure occurs simultaneous with failure of specified electrical power systems.

- GDCs 35, 36, and 37 require an Emergency Core Cooling System (ECCS) design that meets performance, inspection, and testing requirements.
- GDCs 38, 39, and 40 require a Containment Heat Removal system design that meets performance, inspection, and testing requirements.

Quality assurance criteria provided in Appendix B to 10 CFR Part 50 include:

- Criteria III and V require measures to ensure that applicable regulatory requirements and the DB, as defined in 10 CFR 50.2, "Definitions," and as specified in the license application, are correctly translated into controlled specifications, drawings, procedures, and instructions.
- Criterion XI requires a test program to ensure that the subject systems will perform satisfactorily in service and requires that test results shall be documented and evaluated to ensure that test requirements have been satisfied.
- Criterion XVI requires measures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected, and that significant conditions adverse to quality are documented and reported to management.
- Criterion XVII requires maintenance of records of activities affecting quality.

Regulatory requirements covering TSs are provided in 10 CFR 50.36(c). Categories covered include (1) safety limits, limiting safety systems settings, and limiting control settings; (2) Limiting Conditions of Operations (LCOs); (3) SRs; (4) design features; and (5) administrative controls. Of particular interest here with respect to operability is 10 CFR 50.36(c)(2) that defines the LCO as the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the condition can be met. The purpose of the changes proposed by TSTF-523 that revises SRs related to gas accumulation, as stated in 10 CFR 50.36(c)(3), is to verify that the LCO is met and the LCO requires the system to be Operable."

Plants typically are designed and licensed so that systems, such as the ECCS and RHR system, are to be in a water-solid condition<sup>6</sup>. Consequently, for most licensees, whether stated

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<sup>6</sup> Voids that have no effect on operation, such as isolated bubbles or voids in heat exchangers that cannot be removed and will not affect operation, may be considered to exist under water-solid conditions.



or not, the current DB for the subject systems is a water-solid condition. This was reiterated in Nuclear Energy Institute (NEI) 09-10 and the accompanying NRC Safety Evaluation (SE) (NEI, April, 2013) which stated "If there is no specified design limit then the design limit is no gas present." It is also identified in TSTF-523 Revision 2 (NRC, February 21, 2013) by such statements as "The NRC was concerned that the design condition, with some exceptions, is water-solid and the system may not be restored to this condition." To be completely consistent with the DB, the subject systems should be water-solid when transitioning from an outage into power operation.

It is not always practical to maintain a water-solid condition in existing nuclear power plant systems and voids may be acceptable provided operability is reasonably maintained and the voids are removed as soon as is practical<sup>7</sup>. This is consistent with (1) TIA 2008-03 (NRC, October 21, 2008) that stated that system piping can be considered filled with water if system operability has been established, (2) TSs that require the ECCS to be operable in MODES 1 and 2 and in MODE 3 if the RCS is pressurized above a stated level, and (3) TSs that require RHR loop locations susceptible to gas accumulation are sufficiently filled with water.

With respect to operability, the objective is to reasonably ensure that subject system operability is achieved and a reasonable expectation test applies. This means that a high degree of confidence applies but absolute assurance is not necessary. The determination can be based on analyses, test or partial test, experience, and/or engineering judgment (NRC, January 31, 2014).

Also of interest are the regulations in 10 CFR 50.46 that provide specified ECCS performance criteria.

### **Background:**

Instances of gas accumulation in plant systems have occurred since the beginning of commercial nuclear power plant operation. The NRC has published 21 Information Notices (INs), three GLs, and NUREG and NUREG/CRs related to this issue and has interacted with the nuclear industry many times in relation to these publications and in response to gas accumulation events. Despite this history, and in many instances inconsistent with the above regulatory requirements, licensees continued to inadequately address gas accumulation issues. This situation changed as a result of plant shutdowns due to gas issues, workshops to address the issues, and following publication of GL 2008-01 and the Institute of Nuclear Power Operations Significant Operating Event Report (SOER) 2-05 (INPO, January 9, 2008).

GL 2008-01 requested that each addressee evaluate its ECCS, Decay Heat Removal system, and containment spray system licensing basis, design, testing, and corrective actions to ensure that gas accumulation is maintained less than the amount that challenges system operability. The INPO SOER 2-05 Rev. 1 also recommended that licensees take appropriate action when conditions adverse to quality are identified. The combination of inspections, plant shutdowns, workshops, meetings, GL 2008-01, and INPO SOER 2-05 Rev. 1 resulted in an in-depth

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<sup>7</sup> "As soon as is practical" may be (1) at the time of discovery, (2) the next outage, or (3) it may not be practical to remove gas. However, operability must be maintained or the plant must be shut down as required by applicable TSs.

industry effort to address many of the issues. This resulted in a significant and continuing improvement in addressing gas management issues, although further NRC guidance and improvement is needed for some issues, such as gas transport, vortexing, and addressing the DB.

NEI 09-10 Revision 1a-A (NEI, April, 2013), hereafter referred to as NEI 09-10, addressed issues that were identified in GL 2008-01 and INPO SOER 2-05 Rev. 1, during evaluations of industry operations, and in meetings and workshops. It provided recommendations and guidance to nuclear power plant licensees for development and implementation of programs and processes to prevent and manage gas intrusion and gas accumulation in plant systems. The focus was on aspects necessary to maintain operability. This was endorsed in an NRC SE and announced in a Regulatory Issue Summary (RIS).

The NRC is aware of many potentially significant gas intrusion events that have occurred since GL 2008-01 was issued for comment.<sup>8</sup> To assess the licensee's evaluations and actions, the NRC requested the licensees "submit information to demonstrate that the subject systems are in compliance with the current licensing and design bases and applicable regulatory requirements, and that suitable design, operational, and testing control measures are in place for maintaining this compliance." The NRC further stated that it would "collect the requested information to determine if additional regulatory action is required." The licensees were requested to submit a written response consistent with the requested actions and information within 9 months of the issuance of the GL. A preliminary assessment of each 9-month licensee response was completed by the NRC staff to determine whether sufficient information was provided to complete the review and close out the GL.

The reviews determined that the FSARs at many facilities stated that the subject systems were full of water and plant TS often required periodic surveillances to confirm this condition. Most plant DBs require a water-solid condition.<sup>9</sup> Some plant TSs have incomplete SRs that cover only portions of the systems. Since the subject systems could be rendered inoperable or degraded by gas accumulation in any section of piping or by ingestion of gas while draining tanks or from sumps, the regulations require assessment of gas issues to establish operability. In recognition of practical operation considerations, some level of gas accumulation may not affect operability as determined by licensee void acceptance criteria that are acceptable to the NRC. However, the NRC staff position is that such gas accumulation should be corrected at the earliest practical times.

Criterion III of Appendix B to 10 CFR Part 50 and the plant's operating license identify regulatory requirements for the design of systems that are important for safety. The failure to translate the DB (such as the system being maintained full of water) into drawings, specifications, procedures, and instructions would be contrary to Criterion III. System designs vary widely

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<sup>8</sup> 39 instances of discovery of gas at one site were identified in one licensee document during an inspection at a two unit site. The document also identified multiple cases of unexpected accumulator level changes. A significant increase in the discovery and response to gas voids occurred after the NRC started pursuing this issue, an indication of increased licensee recognition of the potential impact.

<sup>9</sup> "Water-solid", "gas-free", and "free-of gas" mean there is no gas with the exception of isolated gas bubbles that cannot be removed by practical means. Other terms, such as "filled with water," mean there is sufficient water to reasonably ensure system operability. (TIA, October 21, 2008)

regarding potential gas sources and capability to control gas. Potential gas sources and symptoms of gas leakage from those sources should be identified and potential gas accumulation locations should be known and provisions made to address gas accumulation at those locations. Additionally, Criteria V and XI and the plant operating license require licensees to perform testing using written test procedures that incorporate the requirements and acceptance limits contained in applicable design and licensing documents. Criterion XVII requires keeping appropriate records. Testing of portions of piping and components in systems where unacceptable gas accumulation may occur is necessary to confirm acceptance limits and operability unless it has been acceptability established that some portions may be excluded. Surveillance and testing that do not ensure operability prior to the next surveillance are not consistent with this testing requirement.

Lastly, the reviews identified that some licensees have treated the accumulation of substantial gas quantities as an expected condition rather than a nonconforming condition and have not documented the condition when discovered even when it involved a substantial volume of gas that clearly constituted a significant condition adverse to quality and safety.

Meetings were conducted with the NEI, owners groups, several industry organizations, and licensees to identify additional information needed to be submitted to the NRC. On May 28, 2009, the NRC issued an assessment guidance document to clarify to the licensees what information was needed to be submitted to the NRC to facilitate close out of the GL (Ruland, May 28, 2009). Licensees used this assessment guidance to determine if they wanted to supplement their original submittals.

The staff has completed the detailed review of the licensee responses to GL 2008-01. The reviews assessed the information provided by the licensees to support a conclusion that there is a reasonable assurance that the subject systems are operable. The staff issued individual plant closure letters after plant responses were received, reviewed, and accepted. After all individual plant closure letters were issued, the staff issued a GL 2008-01 closure memorandum (Rosenberg, July 7, 2011).

The staff provided Temporary Instruction 2515/177 (NRC, May 23, 2011) to provide background information and guidance for inspectors to verify that the onsite documentation, system hardware, and licensee actions were consistent with the information provided in the licensee's response to GL 2008-01. The staff also provided the regions with generic<sup>10</sup> and plant-specific inspection guidance for TI 2515/177.

The closure of GL 2008-01 closed the immediate operability issue as defined in the GL. However, it did not close out the gas accumulation and management issue since a number of issues were identified during the GL evaluation that remained to be fully addressed.

### **Regulatory Outcome:**

As stated above, closure of GL 2008-01 closed the immediate operability issue as defined in GL 2008-01. It did not, however, close out all of the gas accumulation and management issues.

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<sup>10</sup> (NRC, May 23, 2011) is the latest version of the generic guidance.

The staff continued to work with industry through NEI to develop a revised NEI 09-10 that was found acceptable via an SER (NRC, April, 2013). This was followed by RIS 2013-09 to announce endorsement of the revision (NRC, August 23, 2013). These documents:

- conformed to and reinforced previously established NRC regulations,
- reinforced previously issued guidance such as contained in GL 2008-01, various inspection guidance documents [(NRC, May 23, 2011), (NRC, April 16, 2008), (NRC, February, 1978), and (NRC, April 16, 2008)], and discussed in meetings such as those identified in the table at the beginning of this document,
- documented in one location practices that are in widespread use,
- provided insights and attributes to implement aspects of an acceptable approach to effectively prevent and manage gas intrusion and accumulation in plant systems,
- provided an aid in the identification of susceptible systems,
- outlined principles and practices designed to effectively prevent, identify, manage and monitor accumulation of gas that would challenge the capability of a system to perform its functions as designed,
- identified training to ensure plant personnel can readily recognize and effectively respond to gas intrusion and accumulation in susceptible systems,
- provided guidance for addressing gas management issues,
- added value to NRC and industry activities by detailing methods of resolving gas accumulation issues, and
- will improve the efficiency of licensing processes such as associated with license amendment requests since licensees can reference NEI 09-10, the accompanying SE, and RIS 2013-09 in the same manner as they can reference previously approved NRC documents such as SEs.

With respect to application of computer codes, NEI 09-10 stated “that any computer code used to develop a system specific model should be verified to be applicable to solve problems involving gas transport in piping systems via comparisons with laboratory test data or other appropriate methods. Further, a suitable safety factor should be added to predicted results to reasonably ensure the predictions encompass actual behavior.” Details associated with entrance of gas into systems due to vortexing (gas ingestion from hot leg pipes, storage tanks, and recirculation sumps), were outside of the NEI 09-10 scope.

Application of computer codes to assess gas movement, associated gas movement methodologies, and vortexing have been addressed by preparing additional guidance documents, providing inspection support, and preparation of a draft NUREG. Completion of this Action Plan includes addressing these by publication of an update to the draft NUREG and other documentation.

With respect to TSs, 10 CFR 50.36(c)(3) states that SRs are "...requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met." The Standard STS, NUREGs 1430 – 1434, currently include a SR for ensuring the ECCS is full of water consistent with the NRC staff concluding that this is a necessary requirement to reasonably ensure ECCS operability<sup>11</sup>. Operating experience, industry investigations, and NRC activities such as inspections have demonstrated that the TSs and STS are incomplete since they do not address all systems that are important to safety where gas accumulation could cause inoperability. Consequently, STS and TSs must be improved consistent with NRC Administrative Letter 98-10 that addresses response to TSs that may not assure safety (Roe, December 29, 1998).

The goal of gas management TSs is to address system SRs and acceptance criteria for gas voiding in an enforceable manner. Industry submitted TSTF-523 Revision 0 on June 29, 2010. In a July 15, 2010 meeting, ITSB staff stated that entirely removing the gas volume SR from the TSs, as included in TSTF-523, will not be acceptable. In September 30, 2010 and January 12, 2011 meetings, the Staff raised questions about the TSTF but no changes were made in TSTF-523. The staff accepted TSTF-523 for review on March 2, 2011 and determined that it would remove the SRs from the TSs and only insert gas management operability information into the Limiting Condition for Operation (LCO) Bases. TSTF-523 would also add a gas management program to the updated FSAR.

Following a determination that the proposed TSTF was unacceptable, the NRC staff continued to work with industry through the TSTF to develop acceptable gas management TSs to further ensure adequate protection of the public. The model SE for plant-specific adoption of TSTF 523, Revision 2, is available in Agencywide Documents Access and Management System (ADAMS) under Accession No. ML13255A169. Minor editorial comments were received from the Notice of Opportunity for Public Comment announced in the *Federal Register* on August 2, 2013

(78 FR 47010). Disposition of comments received is available in ADAMS under Accession No. ML13255A403. On January 15, 2014 the staff issued a Notice of Availability in the *Federal Register* for TSTF-523, Revision 2.

### **Project Management Structure:**

This project is being performed as a matrix organizational structure. Team members will support project activities directly but will report administratively through their normal management chain. Approvals will be achieved through the standard concurrence process.

Responsible Division Director: Timothy J. McGinty, NRR/DSS

Responsible Branch Chiefs: Eric R. Oesterle, SRXB

Responsible Individuals: Warren C. Lyon, Jennifer M. Whitman, and Diana Woodyatt, SRXB

Other stakeholders and roles:

DPR/PGCB: Alexander D. Garmoe – support issuance of Generic Communications

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<sup>11</sup> Some licensees have less TS coverage than provided in the STS

DSS/STSB: Matthew E. Hamm - TS support  
DPR/PRPB: Michelle C. Honcharik - TSTF support  
DPR/PLPB: Anthony J. Mendiola and Joseph Holonich - NEI 09-10 and NUREG support;  
Jonathan Rowley - Pressurized Water Reactors Owners Group (PWROG) support  
DORL: PMs, Support TS amendment changes  
NRO/DSRA/SRSB  
NRO/DCIP/CTSB  
NRC regions and inspectors

Industry: TSTF, NEI, PWROG, Boiling Water Reactors Owners Groups, industry participants

**Project Attributes:**

As illustrated in the above schedule, this gas management action plan consists of four phases. The first phase involved continued collection of information and evaluation of the licensee's responses to GL 2008-01. Objectives of this phase included determining reasonable assurance of operability of each licensee and determining the need for additional regulatory requirements. Internal inspection guidance was sent to the regions and public individual closure letters were sent to the plants. This phase of the gas management action plan was completed by closeout of the GL.

The second phase involved completion of comprehensive gas management documentation including preparation of a SE and implementation of a RIS. This established an NRC position on gas management and served to endorse NEI 09-10 that outlined a method of gas management.

The third phase was to establish enforceable adequate protection in the area of gas intrusion by completion of a TSTF followed by its implementation. The objectives were to establish a TSTF that provided a gas management program in TS administrative controls sections with a SR in the limiting condition for operation sections. TSTF-523 is available for adoption by licensees and has been adopted by many licensees. The third phase will be completed with implementation of the TSTF by all licensees. Voluntary acceptance of the TSTF by all licensees is the preferred approach; however, it may be necessary to establish a GL or other appropriate communication to implement the TSTF.

The fourth phase is to address all issues including those associated with vortexing, calculation of gas movement, operability, and the DB. This will be accomplished by providing inspection support, issuing a NUREG, and issuing other documentation such as a regulatory guide.

**Project success criteria include:**

- (1) Publication of a NUREG that describes NRC practices regarding vortexing, gas transport, the DB, and other issues.
- (2) Licensees implement the TSTF to ensure improved adequate protection of public health and safety.

**Current Status:**

GL 2008-01 responses have been reviewed, individual plant closure memos have been transmitted to licensees. The GL review was closed by (Rosenberg, July 7, 2011).

2515/177 inspections are complete. SRXB staff continues to provide inspection support when requested.

The SRXB staff has completed a draft NUREG that provides comprehensive coverage of gas issues. The NRC staff is continuing to meet with NEI/Industry to address follow-up items such as vortexing, void transport methodologies, and DB issues.

**Potential Problems:**

Potential Problem	Response
Regional inspections inconsistent with SRXB conclusions.	Continue to provide SRXB support for plant-specific inspection guidance. Provide a NUREG to document resolution of vortex, gas transport, operability, DB, and other issues. Provide a reference that regional inspectors may use during inspections that describes acceptable practices.
Industry failure to implement TSTF	Consider issuing GL similar to GL-2006-01 or other appropriate generic communication.

**Closeout Criteria:**

This action plan will be complete when:

- (1) NRC has issued a NUREG as described above.
- (2) NRC has issued other documents that are found necessary such as a regulatory guide
- (3) Responses to TSTF-523 have been completed.
- (4) All licensees have implemented TSs that establish acceptable adequate protection in the area of gas intrusion in plant piping.

**Proposed Resources and Re-prioritization:**

SRXB: 1.5 FTE

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Jennifer M. Whitman (SRXB) 415-3253  
Diana Woodyatt (SRXB) 415-1245  
Eric Oesterle (acting BC, SRXB) 415-1014

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