August 13, 2010

Scott M. Head
Regulatory Affairs Manager
South Texas Project Nuclear Operating Company
PO Box 289
Wadsworth, TX 77483

SUBJECT: SOUTH TEXAS PROJECT NUCLEAR OPERATING COMPANY AIRCRAFT IMPACT ASSESSMENT INSPECTION, NRC INSPECTION REPORT NO. 05200001/2010-202 AND NOTICE OF VIOLATION

Dear Mr. Head:

On May 17-21, 2010, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection of the South Texas Project Nuclear Operating Company (STPNOC) Aircraft Impact Assessment (AIA) pertaining to activities conducted in support of your application, dated June 30, 2009, requesting an amendment to the U.S. Advanced Boiling Water Reactor (ABWR) design certification rule. This inspection was performed in the offices of ANATECH Corporation located in San Diego, CA. The purpose of the inspection was to perform a limited-scope inspection to assess STPNOC's compliance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.150, "Aircraft impact assessment." The enclosed report presents the results of this inspection. This inspection report does not constitute NRC's endorsement of your overall AIA.

Based on the results of this inspection, the NRC staff determined that a violation of an NRC requirement occurred. The violation is cited in the enclosed Notice of Violation (NOV) and the examples and circumstances surrounding it are described in detail in the subject inspection report. The NOV cites that STPNOC did not use realistic analyses for certain aspects of its AIA and did not fully identify and incorporate into the design those design features and functional capabilities credited. With the exception of the issues identified in the NOV, the NRC inspection team concluded that the STPNOC AIA complies with the applicable requirements of 10 CFR 50.150.

You are required to respond to this letter and should follow the instructions specified in the enclosed notice when preparing your response. The NRC will use your response, in part, to determine whether enforcement action is necessary to ensure compliance with regulatory requirements.

It is important to note that the NRC inspection team performed a limited review of the AIA. Many of the deficiencies identified may also affect other portions of the AIA that the NRC inspection team did not review. Therefore, STPNOC must extend its review, where applicable, beyond the specific examples identified by the inspection team and apply corrective actions as appropriate. In its response to this violation, STPNOC should document the areas for which it extended its review beyond the specific examples of the deficiencies identified by the inspection team, the extent of its review, the additional findings, and the corrective actions implemented.

In addition, the NRC inspection team reviewed the activities associated with the oversight provided by STPNOC. The inspection team determined that the assessment development process would benefit from additional scrutiny. Oversight enhancements should be factored into STPNOC's response to the NOV.

In accordance with 10 CFR 2.390 of the NRC's "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response, if applicable, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,
/RA/

Richard Rasmussen, Chief
Quality and Vendor Branch B
Division of Construction Inspection
& Operational Programs
Office of New Reactors

Docket No.: 05200001

Enclosures:
1. Notice of Violation
2. Inspection Report No. 05200001/2010-202 and Attachments

In addition, the NRC inspection team reviewed the activities associated with the oversight provided by STPNOC. The inspection team determined that the assessment development process would benefit from additional scrutiny. Oversight enhancements should be factored into STPNOC's response to the NOV.

In accordance with 10 CFR 2.390 of the NRC's "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response, if applicable, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,
/RA/
Richard Rasmussen, Chief
Quality and Vendor Branch B
Division of Construction Inspection
& Operational Programs
Office of New Reactors

Docket No.: 05200001
Enclosures:
1. Notice of Violation
2. Inspection Report No. 05200001/2010-202 and Attachments

Distribution:

Public	RidsOgcMailCenter	BJain	RPrato	GThomas
RidsNroDnrlNwe1	RidsAcrsAcnwMailCenter	NGilles	DAndrukat	PKallan
RidsNroLAKGoldstein	MTonacci	MCaruso	YDiaz-Castillo	MBanerjee
RidsRgn2MailCenter	BThomas	BTegler	DJeng	

ADAMS Package Accession No.: **ML102100218** *concurred via email

OFFICE	NRO/DE/SEB1	NRO/DSRA/SPRA	NRO/DSRA/SBPA	NRO/DCIP/CQVA	NRO/DCIP/CHPB
NAME	BJain *	MCaruso*	DAndrukat*	YDiaz-Castillo*	TFrye*
DATE	06/21/2010	07/01/2010	07/01/2010	06/21/2010	07/01/2010
OFFICE	NRO/DCIP/CQVA	NRO/DCIP/CQVA/BC	NRO/DE/SEB1/BC	NRO/DRNL/DDIP/NR	QTE
NAME	RPrato*	JPeralta*	BThomas*	NGilles*	QTE Resources *
DATE	06/ 30 /2010	07/20/2010	08/02/2010	07/21/2010	07/01/2010
OFFICE	NRO/DNRL/DDLO/NG	AIA FRP Chair	NRO/DCIP/CQVB/BC	OGC/GCHEA/AGCMLE	
NAME	PKallan*	JTappert	RRasmussen	CScott	
DATE	07/ 27/2010	08/4/2010	08/13/2010	08/6/2010	

OFFICIAL RECORD COPY

COL – STP Nuclear – South Texas Mailing List (Revised 03/03/2010)
cc:

Certrec Corporation
4200 South Hulen, Suite 422
Fort Worth, TX 76109

Mr. Brian Almon
Public Utility Commission
William B. Travis Building
PO Box 13326
1701 North Congress Avenue
Austin, TX 78701-3326

Ms. Michele Boyd
Legislative Director
Energy Program
Public Citizens Critical Mass Energy
and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

Mr. Ted Enos
4200 South Hulen
Suite 422
Ft. Worth, TX 76109

Ms. Susan M. Jablonski
Office of Permitting, Remediation
and Registration
Texas Comm. On Env. Quality
MC-122
P.O. Box 13087
Austin, TX 78711-3087

Judge
Matagorda County
Matagorda County Courthouse
1700 Seventh Street
Bay City, TX 77414

C. Kierksey
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

M. A. McBurnett
VP, Oversight/Regulatory Affairs
STP Nuclear Operating Company
4000 Avenue F, Suite A
Bay City, TX 77414

Bill Mookhoek
Licensing Supervisor
STP Units 3 and 4
Project Electric Generating Station
P.O. Box 289
Wadsworth, TX 77483

Mr. Terry Parks
Chief Inspector
Texas Department of Licensing
and Regulation
Boiler Division
P.O. Box 12157
Austin, TX 78711

Kathy C. Perkins, RN, MBA
Assistant Commissioner
Division for Regulatory Services
Texas Department of State Health Services
P.O. Box 149347
Austin, Texas 78714-9347

Policy Director
Environmental and Natural Resources
P. O. Box 12428
Austin, TX 78711-3189

Mr. Frank M. Quinn
8 Oak Avenue
Gaithersburg, MD 20877-2705

COL – STP Nuclear – South Texas Mailing List

Regional Administrator
Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive
Suite 400
Arlington, TX 76011-8064

Alice Hamilton Rogers, PE
Inspections Unit Manager
Texas Department of State Health Services
P.O. Box 149347
Austin, Texas 78714-9347

J. J. Sheppard
President & CEO
STP Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

Mr. Robert E. Sweeney
IBEX ESI
4641 Montgomery Avenue
Suite 350
Bethesda, MD 20814

Mr. Steve Winn
STP Nuclear Operating Company
1301 McKinney, Suite 2300
Houston, TX 77010

Mr. Jon C. Wood
Cox, Smith, & Matthews
112 East Pecan, Suite 1800
San Antonio, TX 78205

COL – STP Nuclear – South Texas Mailing List

Email

APH@NEI.org (Adrian Heymer)
awc@nei.org (Anne W. Cottingham)
BrinkmCB@westinghouse.com (Charles Brinkman)
chris.maslak@ge.com (Chris Maslak)
cindyrae_52@yahoo.com
cwaltman@roe.com (C. Waltman)
david.lewis@pillsburylaw.com (David Lewis)
Derlinda.Bailey@chguernsey.com (Derinda Bailey)
- 4 -illia.woodlan@luminant.com (Donald Woodlan)
dwstillwell@stpegs.com (Bill Stillwell)
eliza.seedcoalition@gmail.com (Elza Brown)
erg-xl@cox.net (Eddie R. Grant)
gzinke@entergy.com (George Alan Zinke)
- 4 -illia.head@ge.com (Jerald G. Head)
jgutierrez@morganlewis.com (Jay M. Gutierrez)
jim.riccio@wdc.greenpeace.org (James Riccio)
JJNesrsta@cpsenergy.com (James J. Nesrsta)
John.O'Neill@pillsburylaw.com (John O'Neill)
Joseph_Hegner@dom.com (Joseph Hegner)
junichi_uchiyama@mnes-us.com (Junichi Uchiyama)
- 4 -illi@seedcoalition.org (Karen Hadden)
kdrichards@stpegs.com (Kevin Richards)
Ksutton@morganlewis.com (Kathryn M. Sutton)
kwaugh@impact-net.org (Kenneth O. Waugh)
lchandler@morganlewis.com (Lawrence J. Chandler)
- 4 -illi.eichenberger@ge.com (Louis Eichenberger)
mamcburnett@stpegs.com (Mark McBurnett)
Marc.Brooks@dhs.gov (Marc Brooks)
maria.webb@pillsburylaw.com (Maria Webb)
mark.beaumont@wsms.com (Mark Beaumont)
Mark.Crisp@chguernsey.com (Mark Crisp)
matias.travieso-diaz@pillsburylaw.com (Matias Travieso-Diaz)
maurerbf@westinghouse.com (Brad Maurer)
media@nei.org (Scott Peterson)
MSF@nei.org (Marvin Fertel)
nirsnet@nirs.org (Michael Mariotte)
Nuclaw@mindspring.com (Robert Temple)
patriciaL.campbell@ge.com (Patricia L. Campbell)
paul.gaukler@pillsburylaw.com (Paul Gaukler)
Paul@beyondnuclear.org (Paul Gunter)
pshastings@duke-energy.com (Peter Hastings)
RJB@NEI.org (Russell Bell)
sabinski@suddenlink.net (Steve A. Bennett)
- 4 -illia.sloan@areva.com (Sandra Sloan)

COL – STP Nuclear – South Texas Mailing List

sfrantz@morganlewis.com (Stephen P. Frantz)
smhead@stpegs.com (Scott Head)
- 5 -illiam.moen@ge.com (Stephan Moen)
Tansel.Selekler@nuclear.energy.gov (Tansel Selekler)
tom.miller@hq.doe.gov (Tom Miller)
Vanessa.quinn@dhs.gov (Vanessa Quinn)
vochoa@mail.utexas.edu
Wanda.K.Marshall@dom.com (Wanda K. Marshall)
wayne.marquino@ge.com (Wayne Marquino)
wemookhoek@stpegs.com (Bill Mookhoek)
- 5 -illiam.maher@fpl.com (William Maher)

NOTICE OF VIOLATION

South Texas Project Nuclear Operating Company
Wadsworth, TX 28202

Docket Nos.: 05200001
Inspection Report No.: 2010-202

During a U.S. Nuclear Regulatory Commission (NRC) inspection of South Texas Project Nuclear Operating Company (STPNOC) aircraft impact assessment (AIA) conducted at the ANATECH Corporation, facility in San Diego, CA, on May 17-21, 2010, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

> Title 10, of the *Code of Federal Regulations* (CFR), Section 50.150, "Aircraft impact assessment," Paragraph (a)(1) requires that each applicant listed in 10 CFR 50.150(a)(3) shall perform a design-specific assessment of the effects on the facility of the impact of a large, commercial aircraft. Using realistic analyses, the applicant shall identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions:
>
> (i) the reactor core remains cooled, or the containment remains intact; and
> (ii) spent fuel cooling or spent fuel pool integrity is maintained.
>
> Contrary to the above, as of May 21, 2010, STPNOC failed to use realistic analyses in its AIA. Specifically, the AIA failed to consider the effects of the aircraft impact on the gantry crane; failed to follow through with the alternate missile-target interaction method to determine the extent of damage to the secondary containment wall and its ability to serve as a 3-hour fire rated barrier; failed to accurately determined damage footprints; failed to properly apply the two-barrier rule set resulting in fire doors arranged too close to each other to allow for pressure dissipation; failed to include fire barrier details or to accurately document fire areas; failed to document essential information such as an accurate description of the door to Room 512, an accurate description of the auxiliary feedwater injection (AFI) system, and accurate fire-areas and fire damage footprint drawings; and failed to provide structural design details that were considered within the structural computer model but were not described in the assessment. Further, STPNOC failed to identify and incorporate into the design those design features and functional capabilities credited in the AIA to show the reactor remains cool, or containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained as required by 10 CFR 50.150(a)(1). For example, the STPNOC AIA credited the following design features and functional capabilities that were not identified in the design: the types of damage the AFI instrument cabling could suffer and the design feature(s) needed to prevent that damage; the structural strength of the surge tank room barrier wall; the spent fuel pool steel liner thickness; and the structural strength and reinforcement requirements for reactor building wall locations and barrier doors.
>
> This issue has been identified as Violation 05200001/2010-202-01.
>
> This is a Severity Level IV Violation (Supplement VII).

Pursuant to the provisions of 10 CFR 2.201, "Notice of Violation," STPNOC is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Quality and Vendor Branch 1, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Violation. This reply

should be clearly marked as a "Reply to a Notice of Violation" and should include: (1) the reason for the violation, or, if contested, the basis for disputing the violation or severity level, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, the NRC will consider extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible at http://www.nrc.gov/reading-rm/adams.html, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 13th day of July 2010

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS
VENDOR INSPECTION REPORT

Docket No.:	05200001
Report Nos.:	05200001/2010-202
Vendor:	South Texas Project Nuclear Operating Company PO Box 289 Wadsworth, TX 77483
Vendor Contact:	Scott M. Head Regulatory Affairs Manager (361) 972-7136 E-mail: smhead@stpegs.com
Nuclear Industry Activities:	South Texas Project Nuclear Operating Company (STPNOC) has requested to amend the U.S. Advanced Boiling Water Reactor (ABWR) design certification to comply with the U.S. Nuclear Regulatory Commission (NRC) requirements in Title 10 of the *Code of Federal Regulation* (10 CFR), Section 50.150, "Aircraft impact assessment."
Inspection Dates:	May 17-21, 2010

Inspectors:		
	Robert Prato, Team Leader,	NRO/DCIP/CQVA
	Yamir Diaz-Castillo,	NRO/DCIP/CQVA
	Mark Caruso,	NRO/DSRA/SPRA
	George Thomas,	NRO/DSRA/SRSB
	Dennis Andrukat,	NRO/DSRA/SBPA/SFPT
	David Jeng,	NRO/DE/SEB2
	Nanette Gilles,	NRO/DNRL/DDIP/NRGA
	Bhagwat Jain,	NRO/DE/SEB1
	Dr. J. Guadalupe Argüello,	Sandia National Laboratories
	Dr. Alexander L. Brown,	Sandia National Laboratories

Approved by:	Richard Rasmussen, Chief Quality and Vendor Branch 2 Division of Construction Inspection & Operational Programs Office of New Reactors

ENCLOSURE 2

EXECUTIVE SUMMARY

South Texas Project Nuclear Operating Company
Inspection Report No.: 05200001/2010-202

The purpose of this U.S. Nuclear Regulatory Commission (NRC) inspection was to verify that South Texas Project Nuclear Operating Company (STPNOC) had implemented the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.150, "Aircraft impact assessment," and performed a design-specific assessment[1] of the effects on the facility of the impact of a large, commercial aircraft. The inspection was conducted at the ANATECH Corporation facility in San Diego, CA, during the period May 17-21, 2010.

The following served as the bases for the NRC inspection:

- 10 CFR 50.150

The NRC inspection team implemented Inspection Procedure 37804, "Aircraft Impact Assessment," dated April 27, 2010, during the conduct of this inspection.

The NRC had not previously inspected the STPNOC aircraft impact assessment (AIA). The results of this inspection are summarized below.

With the exception of the violation described below, the NRC inspection team concluded that the STPNOC AIA complies with the applicable requirements of 10 CFR 50.150.

Systems-Loss Assessment

With the exception of the contributing deficiencies to Violation 05200001/2010-202-1 for the failure to perform realistic analyses in the AIA and for failure to identify and incorporate in its design certain design features credited in the AIA, the STPNOC systems-loss assessment met the requirements of 10 CFR 50.150 and was performed consistent with the guidance provided in Nuclear Energy Institute (NEI) 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," issued May 2009. Specifically, with regards to the AIA systems-loss assessment deficiencies, the applicant credited the following design features that were not identified in the design: the auxiliary feedwater injection (AFI) system as described in its AIA, as well as, the design features to protect the AFI system instrument cabling.

Fire Damage Assessment

With the exception of the contributing deficiencies to Violation 05200001/2010-202-1 for the failure to perform realistic analyses in the AIA and for failure to identify and incorporate in its design certain design features credited in the AIA, the STPNOC fire damage assessment met the requirements of 10 CFR 50.150 and was performed consistent with the guidance provided in NEI 07-13. Specifically, with regards to the AIA fire damage assessment deficiencies, the applicant failed to adequately: follow through with the alternate missile-target interaction method to determine the extent of damage to the secondary containment wall and its ability to serve as a

[1] By a ''design-specific'' assessment, the NRC means that the impact assessment must address the specific design of the facility which is either the subject of a construction permit, operating license, standard design certification, standard design approval, combined license, or manufacturing license application (see 74 FR 28129; June 12, 2009).

3 hour fire rated barrier; determine fire damage footprints; and apply the two-barrier rule set resulting in fire doors arranged too close to each other to allow for pressure dissipation. In addition, STPNOC credited fire barrier design features and fire areas that were not identified and incorporate into its design.

Structural Damage Assessment

With the exception of the contributing deficiencies to Violation 05200001/2010-202-1 for the failure to perform realistic analyses in the AIA and for failure to identify and incorporate in its design certain design features credited in the AIA, the STPNOC structural damage assessment met the requirements of 10 CFR 50.150 and was performed consistent with the guidance provided in NEI 07-13. Specifically, with regards to the AIA structural damage assessment deficiency, the applicant failed to address the potential effects of the aircraft impact on the gantry crane in its analyses of the aircraft impact on the refueling floor shield plugs. In addition, STPNOC credited structural design features such as the spent fuel pool liner plate thickness, and Reactor Building interior walls and barrier doors concrete wall strength and reinforcement requirements that were not identified and incorporated into its design.

Documentation and Quality Assessment

With the exception of the observations noted in the report details, the NRC inspection team concluded that STPNOC's AIA documentation and quality-related activities met the requirements of 10 CFR 50.150 and were performed consistent with the guidance provided in NEI 07-13. Specifically, with regards to the AIA document and quality assessment, the NRC inspection team determined that some of the information documented within the STPNOC AIA is incomplete and, in some cases, inconsistent with its design.

REPORT DETAILS

The NRC inspection team performed a systems-loss assessment, a fire-damage assessment, a structural-damage assessment and a documentation and quality assessment in accordance with Inspection Procedure (IP) 37804 to verify that STPNOC had performed a design-specific assessment of the effects on the facility from the impact of a large, commercial aircraft. As part of the overall effort to ensure that applicants identify and incorporate into its design, those design features and functional capabilities to show that, with reduced operator action, the reactor core will remain cooled, or the containment remains intact; and spent fuel pool cooling or spent fuel pool integrity is maintained, the NRC reviewed and commented on industry guidance in NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," for meeting the requirements of 10 CFR 50.150. NEI 07-13, where applied, was determined by the NRC to provide one acceptable approach including the general guidance, rule sets, and applicable assumptions for performing an acceptable AIA to meet the requirements of 10 CFR 50.150. STPNOC credited the approach provided in NEI 07-13 in many areas of its AIA as discussed within this inspection report.

1. Systems-loss Assessment

   a. Inspection Scope

      The NRC inspection team conducted the following systems-loss assessment inspection activities related to the STPNOC AIA in this portion of the AIA inspection:

      - Verification of the location of key structures, systems, and components (SSCs) that provide core cooling or containment isolation, and spent fuel pool cooling to determine the potential for damage by aircraft impact
      - Verification that key SSCs would be capable of performing their intended function given the established structural, shock, and fire damage footprints and the rule sets and assumptions provided in NEI 07-13
      - Verification that damage from an aircraft impact has resulted in accident initiators such as a breach of the reactor coolant system or the failure of the reactor to trip
      - Verification that success paths for core cooling and spent fuel pool cooling exist

      Specifically, the NRC inspection team reviewed the following STPNOC AIA documents:

      - Floyd, S., "Detailed Report Fuel Pool Cooling Assessment Aircraft Impact Assessment for US-ABWR DCD Design," Revision 0, Erin Engineering and Research, Inc. Report No. C177080001-8762, dated May 29, 2009 (Safeguards Information (SGI))
      - GE Nuclear Energy, "ABWR Design Control Document," Tier 2, Revision 4, issued March 1997.
      - GE Nuclear Energy, "ABWR Standard Safety Analysis Report," Report No. 23A6100, Revision 1, issued 1993
      - Westinghouse Electric Company (WEC), "Analysis of Auxiliary Feedwater Injection System for ABWR," Letter Report No. LTR-LAM-09-64, Revision 1, dated May 28, 2009
      - South Texas Project Nuclear Operating Company, "Amendment to Amend the Design Certification Rule for the U.S. Advanced Boiling Water Reactor (ABWR)," Letter Report No. U7-C-STP-NRC-090070, Revision 0, DATED June 30, 2009

- South Texas Project Nuclear Operating Company, "Proposed ABWR DCD AIA Amendment, Revision 1," Letter Report No. U7-C-STP-NRC-100098, Revision 1, dated May 12, 2010

b. Observations and Findings

b.1 Determination of the location of key SSCs

The NRC inspection team reviewed the applicant's selection of SSCs needed to prevent fuel damage in the core and the documented spatial configuration of those SSCs. SSCs needed to maintain containment intact and to provide for spent fuel pool cooling were not reviewed because the applicant indicated that its objective in adding key design features to address the AIA rule was to maintain core cooling and spent fuel pool integrity[2].

The NRC inspection team compared the descriptions of SSCs in the assessment report to those in the DCD and the probabilistic risk analysis (PRA) in the ABWR supplemental safety analysis report and confirmed that the scope of SSCs treated in the assessment was complete and consistent with those needed to satisfy the core cooling success criteria in the PRA. The inspection team used equipment location data and drawings from the certified fire hazards analysis in Section 9A of the DCD to confirm that the locations of equipment documented in the assessment report were accurate.

The NRC inspection team reviewed the description of the AFI system credited in the AIA to assess the consistency with the design identified in the STPNOC design certification amendment (DCA). The system description provided in the AIA was not consistent with the system description in the DCA. The applicant informed the inspection team that the AFI system design was changed and the system description in the STPNOC DCA was updated but they failed to update the AIA AFI system description. STPNOC's failure to provide an accurate AFI system description in the AIA is one example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for not demonstrating sufficient realism in its AIA as required by 10 CFR 50.150(a)(1).

The NRC inspection team verified that documentation used by the applicant to develop and identify spatial information (e.g., internal events PRA, internal flooding analysis, internal fire analysis and building layout diagrams) is current.

[2] The AIA rule requires the applicant to identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions: (I) The reactor core remains cooled, or the containment remains intact; and (ii) spent fuel cooling or spent fuel pool integrity is maintained. Since the applicant has chosen to maintain core cooling and spent fuel pool integrity to meet the rule, further assessment of containment and spent fuel pool cooling is not necessary.

b.2 Determination of the state of SSCs in the aircraft impact scenarios

The NRC inspection team reviewed the AIA to determine whether the applicant had correctly applied the rules and assumptions given in NEI 07-13 for the loss of SSCs. Specifically, the team selected a sample of SSCs that the applicant had identified as remaining functional in one or more scenarios and verified that the bases used to conclude that these SSCs will survive the conditions created by an aircraft impact are consistent with the rules and assumptions given in NEI 07-13.

The NRC inspection team reviewed those portions of the applicant's assessment report that discussed the approach used for identifying which SSCs will remain capable of performing its intended function following an aircraft impact. The inspection team determined that the ECCS and its support systems include three independent and redundant divisions that are physically separated within the reactor and control buildings. The equipment in each division is capable of maintaining core cooling. The instrumentation used to actuate and control the ECCS is divided into four separate and independent divisions. The inspection team determined that the applicant considered none of the equipment to be available in any division affected by structural, shock, or fire damage and, therefore, unavailable to support core cooling. The inspection team compared this approach with the guidelines in NEI 07-13 and verified that it was conservative and bounding with respect to the approach allowed by NEI 07-13.

The NRC inspection team reviewed those portions of the AIA that assessed damage to the SSCs in the AFI system. The inspection team determined that the applicant had assumed that any equipment located in an area of the plant that suffers structural, shock, or fire damage was assumed to be failed at the time the damage occurred without any delay. The inspection team compared this assumption to the guidelines in NEI 07-13 and verified that this approach is conservative and bounding with respect to the approach allowed by NEI 07-13. The NRC inspection team verified that, with the exception of AFI instrument cabling in select locations, the AIA specified the locations for SSCs in the AFI system relative to damage areas.

The applicant acknowledged that it had not completed the design for the AFI instrumentation cable and that the routing information for certain runs of cabling were unavailable. Furthermore, the design does not include design features to ensure that the AFI system cabling would be protected and the AFI system would be available for core cooling. Despite the lack of a design feature to protect the cable, the AIA took credit for the availability of the AFI for core cooling. This is one example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for crediting certain design features not identified in its design contrary to the requirements of 10 CFR 50.150(a)(1).

The NRC inspection team reviewed the applicant's analysis of the AFI system operation, WEC Letter Report No. LTR-LAM-09-64. The inspection team determined that for some impact scenarios the steam vent path could be damaged. The applicant assumed the worst-case condition for venting steam. The NRC inspection team compared this assumption to the guidelines in

NEI 07-13 and verified that this approach is conservative (produces the minimum flow area), and is consistent with guidance in NEI 07-13.

The applicant conducted several calculations as part of the analysis of the AIA system operation to demonstrate the ability of the AFI system to remove decay heat adequately without uncovering the core. These calculations included the following:

- Calculation of the time required to boil-off enough water to uncover the core assuming no AFI injection to show that sufficient time was available to start the AFI system before the core was uncovering. This calculation was done for a full power initial condition and a cold shutdown initial condition.
- Calculation of mass flow rates in and out of the reactor vessel following the initiation of AFI to show that the core remained covered following the initiation of AFI.
- Calculation of the time to reach the containment overpressure protection system (COPS) rupture disk set point to show that sufficient time was available to prepare for venting from the vent stack.
- Calculation of the maximum pressure in the wet well following rupture of the COPS rupture disk to show that the assumed vent flow area was adequate.
- Calculation of the amount of water used to remove decay heat for 24 hours to demonstrate that the capacity of the AFI water source was adequate.

The NRC inspection team reviewed these calculations, including the methods used, assumptions made and input values applied, and verified that each calculation was appropriately formulated, based on sound engineering principles, and sufficient to demonstrate that the AFI system can function successfully to remove decay heat.

The NRC inspection team could not determine whether the AFI system could mitigate a loss-of-coolant accident (LOCA) and verified that the applicant had not credited the AFI for mitigating a LOCA as part of its AIA.

b.3 Determination of accident conditions

The NRC inspection team reviewed the following conditions to determine if the applicant used the appropriate assumptions and scenarios in determining accident conditions:

- The applicant's success criteria (and the scenario analysis) address initial plant states of 100 percent power and cold shutdown.
- The analysis takes no credit for the availability of offsite power.

- The applicant, as part of its shutdown cooling scenarios, assumes that the non operating loop of shutdown cooling is out of service for maintenance, the reactor vessel is vented, the water level is at or near the reactor vessel head flange, and the reactor has been shut down for a specified time.

- The applicant has considered the possibility of an anticipated transient without a SCRAM (ATWS).

- The applicant has considered the influence of containment status on the operability of other equipment (e.g., pumps that draw suction water from the containment sump).

- The applicant has searched for instances in which a containment bypass LOCA may occur.

The team reviewed the applicant's treatment of the following potential accident conditions:

- LOCA inside the containment
- LOCA outside the containment
- ATWS
- flooding
- loss of decay heat removal

LOCA inside containment

The NRC inspection team reviewed the applicant's assessment of a LOCA inside the containment to determine if the containment is adequately protected by intervening structures such that it could not be impacted by an aircraft. The NRC inspection team determined that the assessment adequately demonstrated that neither shock damage to the containment nor structural damage inside the containment would occur and, as such, verified that a LOCA inside the containment will not occur.

LOCA outside containment

The NRC inspection team reviewed the applicant's assessment of a LOCA outside the containment to assess the applicant's design features for piping outside of primary containment that is connected to the reactor coolant pressure boundary, above grade level, and protected from structural damage. The inspection team used elevation and azimuth data provided in Table 6.2-8 of the DCD, as well as plan and elevation drawings of the reactor building to verify that the applicant's assessment effectively determined that the applicable piping was adequately protected from structural damage.

ATWS

The NRC inspection team reviewed the AIA to determine if the applicant adequately assessed the potential for any damage scenarios that could affect the ability to scram the reactor. The inspection team considered potential structural

damage to the hydraulic control units used for reactor scram. The NRC inspection team reviewed drawings from the fire hazards analysis, confirmed that the hydraulic control units are located below grade, outside all structural damage footprints, and verified that ATWS was not a viable outcome from an aircraft impact.

Flooding

The NRC inspection team reviewed the AIA to determine if the applicant adequately assessed the potential for flooding from a large water source as described in NEI 07-13. The NRC inspection team verified that the two potential flow paths for flooding were either located below grade and, therefore, not vulnerable to breach because of an aircraft impact, or were isolable at a remote location away from the reactor or control buildings.

Loss of Decay Heat Removal

The NRC inspection team reviewed the AIA to determine if the applicant adequately assessed the potential for a loss of decay heat removal event. WEC Letter Report No. LTR-LAM-09-64 documents the applicant's analysis for the potential loss of decay heat removal. The NRC inspection team reviewed the assumptions used in the analysis and verified that they were consistent with guidance in NEI 07-13. Specifically, the applicant assumed that the non operating loop of shutdown cooling is out of service for maintenance, the reactor vessel is vented, water level is at or near the reactor vessel head flange, and the reactor has been shut down for a specified time. The NRC inspection team verified that the assessment adequately demonstrated that more than adequate time was available to initiate the AFI system before the core is uncovered.

b.4 Identification of success path

The NRC inspection team reviewed the AIA to determine if the applicant had adequately identified normal decay heat removal methods and the AFI system in conjunction with the COPS as success paths for core cooling. The inspection team reviewed the PRA (GE Nuclear Energy Report No. 23A6100) which serves as the basis for information documented in Chapter 19 of the DCD, and verified that the normal decay heat removal methods identified by the applicant are shown as success paths for avoiding core damage in the PRA.

c. Conclusions

The NRC inspection team found that with the exception of the contributing deficiencies to Violation 05200001/2010-202-1, the STPNOC systems-loss assessment met the requirements of 10 CFR 50.150 and was conducted consistent with the guidance provided in NEI 07-13.

2. Fire Damage Assessment

a. Inspection Scope

The NRC inspection team conducted the following fire damage assessment inspection activities relating to the STPNOC's AIA in this portion of the AIA inspection:

- Verification that the fire damage assessment identifies and incorporates the necessary design features and functional capabilities
- Verification that the fire damage assessment is realistic and design-specific
- Verification that damage footprints include the effects from the spread of fire damage through existing connected compartments and through new compartment connections due to overpressure
- Verification of the SSCs determined to be damaged and no longer credited.

Specifically, the NRC inspection team reviewed the following STPNOC AIA documents:

- Floyd, S., "Detailed Report Fuel Pool Cooling Assessment Aircraft Impact Assessment for US-ABWR DCD Design," Revision 0, Erin Engineering and Research, Inc. Report No. C177080001-8762, dated May 29, 2009 (Safeguards Information (SGI))
- GE Nuclear Energy, "ABWR Design Control Document," Tier 2, Revision 4, issued March 1997.
- South Texas Project Nuclear Operating Company, "Amendment to Amend the Design Certification Rule for the U.S. Advanced Boiling Water Reactor (ABWR)," Letter Report No. U7-C-STP-NRC-090070, Revision 0, DATED June 30, 2009
- South Texas Project Nuclear Operating Company, "Proposed ABWR DCD AIA Amendment, Revision 1," Letter Report No. U7-C-STP-NRC-100098, Revision 1, dated May 12, 2010

b. Observations and Findings

b.1 Damage Footprint Assessment

The STPNOC aircraft impact assessment evaluated a total of 60 different impact scenarios throughout the reactor building and control building in accordance with NEI 07-13. The NRC inspection team reviewed a sample of eight impact scenarios (Nos.: 6, 8, 9, 15, 19, 33, 55, and 60) that included one or more of the following criteria: large fire damage footprints, fire damage footprints resulting in damage to multiple safety divisions, and fire damage footprints that were in close proximity to the AFI system. In addition, the NRC inspection team reviewed the fire damage assessment contained in the ERIN Engineering and Research Inc. report (Reference 1). The NRC inspection team verified that the developed fire damage footprints developed by the applicant as a result of the aircraft impact scenarios reviewed, in general, were consistent with the rules and assumptions given in NEI 07-13.

However, the NRC inspection team did identify fire damage footprints that did not conform to the guidance in NEI 07-13 for developing realistic fire damage footprints that resulted in a number of undersized fire damage footprints. For example, in Strike Location #8 of the assessment the applicant failed to include fire area 4102 and 4302 located on elevations 3F and 4F in the fire damage footprint. Inspectors noted that these fire areas were included in the fire damage footprint for elevation 2F of the same scenario. The NRC inspection team

determined that although the footprints did not include all of the required damaged fire areas, in this application, the resulting outcome did not change based on the fact that the increased footprint remained within an already damaged division. Based on the limited review performed, the inspection team evaluated the undersized fire damage footprints for cause and trends and determined that the causes were random errors and no trends were identified. The undersized fire damage footprints is another example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for not demonstrating sufficient realism in its AIA as required by 10 CFR 50.150(a)(1).

The NRC inspection team reviewed several scenarios to ensure that each fire damage footprint extended beyond the associated physical damage footprint. The inspection team did identify a scenario (Strike Location 12) in which the fire damage footprint did not extend beyond the physical damage footprint. In this scenario, the applicant elected to perform the missile-target interaction method to produce the physical damage footprint in which a single interior wall is credited for stopping both the physical impact and the spread of fire damage.

The NRC inspection team determined that the applicant performed the missile-target interaction method consistent with the structural assessment guidance in NEI 07-13, but failed to implement the guidance in NEI 07-13 on the spread of fire damage. More specifically, the applicant correctly calculated that the wall in question can effectively serve as a barrier that stops further physical propagation, but then assumed that the same wall will also limit further fire propagation. This assumption raises a concern as to the ability of the wall to remain an effective 3-hour fire barrier after the resulting pressure pulse and the physical damage from impact.

NEI 07-13 contains a physical damage footprint rule set (three-wall rule set) that allows applicants to take credit for a third wall being intact following impact without further evaluation to determine if the accumulation of the walls are sufficient to stop the aircraft or if the third wall is intact enough to be credited as a fire barrier. However, the use of an alternate method (such as the missile-target interaction method) was included in NEI 07-13 to allow for the calculation of more realistic results. As such, crediting a wall as an effective fire barrier after impact without further evaluation should not have been assumed and is not the intent of NEI 07-13. Therefore, the NRC inspection team determined that the applicant failed to adequately evaluate the effects on the wall in question from impact and its ability to serve as a fire barrier. The failure to adequately evaluate the effects from impact on the effectiveness of a wall to serve as fire barrier is another example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for not demonstrating sufficient realism in its AIA as required by 10 CFR 50.150(a)(1).

The NRC inspection team reviewed fire damage footprint drawings for the application of NEI 07-13 rule sets for two-barriers, blowout panels, and their barriers beyond the physical damage perimeter that are needed to stop further propagation. The NRC inspection team identified a number of locations in which the applicant had applied the two-barrier rule set (often referred to as the two-door rule set) in such a manner that the two fire barriers with fire doors are arranged too close to each other to allow for pressure dissipation. The locations identified

involve barriers separating safety divisions in which at least one safety division is credited to survive the impact scenario.

NEI 07-13 is silent on specific fire barrier configuration, separation distance, and pressure dissipation. NEI 07-13 did not anticipate some of the configurations used in the STPNOC AIA and only provided guidance for the use of existing room layouts which would allow a full room for pressure dissipation. NEI 07-13 does contain sample figures depicting acceptable two-barrier rule set configurations. Regardless, the NRC inspection team determined that it was not realistic to disregard the need for pressure dissipation and that the assessment should have identified the need for adequate distances and volumes between fire barriers. The applicant did provide draft modifications for relocating those fire barriers that the NRC identified as being poorly arranged. The failure to adequately consider fire barrier configuration, separation distance, and pressure dissipation is another example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for not demonstrating sufficient realism in its AIA as required by 10 CFR 50.150(a)(1).

The NRC inspection team reviewed the fire areas, fire barriers and fire damage footprints credited in AIA and determined that the AIA identified fire barrier details that were not included in its design. For example, the surge tank room barrier on the 4th elevation above grade is identified as a 5 psid wall in the AIA but not in the DCA. In addition, the NRC inspection team identified differences between the fire-areas documented in the DCA and the fire-areas that resulted from the aircraft impact fire damage assessment. For example, within room 411 located on elevation 1F, the DCA drawings show two 3-hour fire doors (one along column line R5.3 and the other along column line RB.2) while the AIA drawings show a single 3-hour fire-rated watertight door along column line R5.3. In another example, the DCA drawings do not show the 3 fire doors located across elevations B1F and B2F which are utilized in the AIA. Other examples show the DCA's Section 9A Fire Hazards Analysis allowing "either a 5-psid door or two 3-hour rated fire doors." (e.g. Room 430, 512, etc). However, the AIA only analyzes for one of these door options per room. The different fire barrier details and fire areas in the STPNOC AIA is another example of a deficiency in the assessment contributing to Violation 05200001/2010-202-1 that cites STPNOC for crediting certain design features not identified in its design contrary to the requirements of 10 CFR 50.150(a)(1).

b.2 Fire Damage Effects on SSCs

The NRC inspection team reviewed a sample of fire damage footprints to determine if the applicant had properly identified all SSCs within the fire damage footprints. The NRC inspection team verified that the applicant had properly identified the SSCs within the fire damage footprint and that the applicant had correctly considered the identified SSCs as failing within 5 minutes of the start of the fire consistent with the guidance provided in NEI 07-13. Further review of damage to the SSCs was conducted and documented as part of the systems-loss assessment.

Alternate Feedwater Injection system

The NRC inspection team reviewed the AFI system and equipment locations inside the Reactor Building. The reactor building contains AFI instrumentation and cabling used to operate the system remotely. The NRC inspection team reviewed 2 of the 21 impact scenarios that rely on the AFI system to mitigate the consequence of an aircraft impact to confirm that the AFI instrumentation and cables survive. In the scenarios reviewed, the NRC inspection team verified that AFI equipment does survive an impact to the reactor building. However, the NRC inspection determined that the description of the AFI system did not provide an adequate description of the location and routing information for certain runs of AFI instrument cabling. Per the Guidance in NEI 07-13, the lack of location and routing information would require the applicant to assume that the cables are damaged. Because the STPNOC AIA relies on the operability of the AFI system, the applicant issued a corrective action report that requires the next DCA update to describe the AFI instrumentation cables as 3-hour fire rated cabling. In addition, the applicant proposed to include a new statement in the DCA committing the end user to ensure that these cables are not routed through any physical damage footprints. The system-loss assessment determined this to be a contributing deficiency to Violation 05200001/2010-202-1.

c. Conclusions

The NRC inspection team found that with the exception of the contributing deficiencies to Violation 05200001/2010-202-1, the STPNOC fire damage assessment met the requirements of 10 CFR 50.150 and was conducted consistent with the guidance provided in NEI 07-13.

3. Structural Damage Assessment

a. Inspection Scope

The NRC inspection team conducted the following structural damage assessment inspection activities related to the STPNOC AIA in this portion of the AIA inspection:

- Verification of information found in plant documentation including plant arrangement drawings that display the locations of major equipment, plant elevation drawings that document the relative heights of various buildings, civil-structural drawings that provide wall thicknesses and reinforcement details, and material specifications
- Verification of general structural analysis considerations such as design inputs, analysis parameters and assumptions, computer codes, methods used for structural analyses and results to determine whether the applicant has adequately analyzed the effects of and damage to structures resulting from global loading arising from an aircraft impact
- Verification of the containment and spent fuel pool impact analyses to determine whether the applicant has met the sufficiency criteria in NEI 07-13, Section 2.5
- Verification of the structural damage footprint assessments to determine whether the applicant has adequately assessed the containment and other reinforced

concrete buildings that contain essential SSCs for maintaining reactor core and spent fuel pool cooling using the damage rule sets in NEI 07-13

Specifically, the NRC inspection team reviewed the following STPNOC AIA documents:

- ST-637, "Transmittal of Beyond Design Basis, Large Aircraft Characteristics," (Note: includes all pages except for the final 3 pages which were originally marked 14-16, destroyed by R. S. Dunham on 10/27/2009), transmitted by Mary Ann Bradford, RMS, March 9,2009 (SGI)
- James, R. J. and Y. R. Rashid, "Evaluation of Aircraft Impact on Toshiba-WEC U.S.-ABWR Plant Design – Structural Response Analyses for DCD Amendment," Report No. ANA-08-0741, ANATECH Corporation, San Diego, CA, Revision 0, issued May 2009 (SGI)**
- "ANATECH Corporation, Evaluation of Aircraft Impact on U.S.-ABWR Plant Design for STP Project, Volume 2, Design Input Control," ANATECH, San Diego, CA, issued September 2008**
- "ANATECH Corporation, TeraGrande Software Validation for AIA," ANATECH Corporation, San Diego, CA (SGI)**
- "ANATECH Corporation, TERAGRANDE CONFIGURATION CONTROL and VERIFICATION," ANATECH Corporation, San Diego, CA, May 3, 2010 (Note, this document contains: TeraGrande Verification Plan [ANA-R-10-0756]; TeraGrande Functionality & Verification Problems [ANA-R-10-0758]; TeraGrande Verification Problem Descriptions [ANA-R-10-0759]; ANATECH's Configuration Control of TeraGrande Using CVS [ANA-R-10-0757]; and NEI Explicit Verification Manual, Version 9.2)**
- "ANATECH Corporation, TeraGrande User's Manual," Version1.0, ANATECH Corporation, San Diego, CA, issued 2005-2007**
- "ANATECH Corporation, TeraGrande Description & Theory," ANATECH Corporation, San Diego, CA, issued May 3, 2010**
- "ANATECH Corporation, ANACAP-U ANATECH Concrete Analysis Program Version 2.3," User's Manual, ANATECH Corporation, San Diego, CA, issued December 1994 (DRAFT)**
- "ANATECH Corporation, ANACAP-U/ANAMAT Theory Manual Version 2.5," Revision 0 (DRAFT), ANATECH Corporation, San Diego, CA, April 1998**
- "ANACAP-U ANATECH Concrete Analysis Package Version 2.5, Verification and Validation Manual," ANA-QA-144, revision 1 draft, ANATECH Corporation, San Diego, CA, issued September 1998**
- "ANATECH Corporation, Constitutive Modeling of Reinforced Concrete and Steel," ANA-96-0188, Rev. 2, ANATECH Corporation, San Diego, CA, issued October 1996**
- Floyd, Stephen, "Detailed Report Fuel Cooling Assessment Aircraft Impact Assessment for U.S.-ABWR DCD Design," Rev. 0, C177080001-8762, ERIN Engineering and Research, Inc., dated May 29, 2009 (SGI)**
- Floyd, Stephen, "Detailed Report Fuel Cooling Assessment Aircraft Impact Assessment for U.S.-ABWR DCD Design," Rev. 0, Appendix D-2 "Enhanced Strike Plots", C177080001-8762, ERIN Engineering and Research, Inc., dated May 29, 2009 (SGI)
- Floyd, Stephen, "Detailed Report Fuel Cooling Assessment Aircraft Impact Assessment for U.S.-ABWR DCD Design," Rev. 0, Appendix A-2 "Initial Strike

Plots", C177080001-8762, ERIN Engineering and Research, Inc., dated May 29, 2009 (SGI)

- ANATECH Corporation, "Evaluation of Aircraft Impact on U.S.-ABWR Plant Design for STP Project – Record of Analysis," San Diego, CA, May 2009**
- ANATECH Corporation, "Supplemental Description of Modeling Used in AIA Structural Evaluations," dated May 19, 2010
- GE Nuclear Energy, "ABWR Design Control Document", Tier 2, Revision 4, issued March 1997.
- South Texas Project Nuclear Operating Company, "Amendment to Amend the Design Certification Rule for the U.S. Advanced Boiling Water Reactor (ABWR)," Letter Report No. U7-C-STP-NRC-090070, Revision 0, DATED June 30, 2009
- South Texas Project Nuclear Operating Company, "Proposed ABWR DCD AIA Amendment, Revision 1," Letter Report No. U7-C-STP-NRC-100098, Revision 1, dated May 12, 2010

b. Observations and Findings

b.1 Structural Assessment Document Review

The NRC inspection team reviewed the applicant's plant structural assessment design inputs including plant arrangement drawings, plant elevation drawings, civil-structural drawings, and material specifications. As part of this review, the inspection team identified discrepancies in reference to the revision of the DCA relative to material specifications. Material specifications presented in Table II-1, "Summary of Input Specifications," in ANATECH Report No. ANA-08-0741 refer to Revision 4 to the DCA, whereas the material specifications (on page 1) of "ANATECH Corporation, Evaluation of Aircraft Impact on U.S.-ABWR Plant Design for STP Project, Volume 2, Design Input Control" refer to Revision 0 of the DCA. Upon further review the NRC inspection team determined that much of the information remained the same among the different revisions of the AIA DCA. The NRC inspection team verified that the material specifications did not change between Revision 0 and Revision 4 to the AIA DCA. The inspection team also verified that the plant arrangement drawings display the locations of major equipment, the plant elevation drawings identified the relative heights of various buildings, and the civil-structural drawings provided wall thicknesses and reinforcement details accurately and consistent with the ABWR DCD.

b.2 General Structural Analysis

- The NRC inspection team reviewed the AIA structural damage assessment including design inputs, analysis parameters and assumptions, computer codes, method used for structural analyses and results. The inspection team reviewed the design inputs including the structural analysis assumptions and limitations, the type of finite elements used in each analysis, material models considered, sensitivity to model mesh refinement, and the time duration of the analysis and verified that the applicant had adequately documented and justified the structural design input for each analysis.

The NRC inspection team determined that the applicant had not adequately documented the finite element analyses, the boundary conditions, the initial conditions, and the time duration used in the analyses. However, during the course of the inspection, the applicant's subcontractor, ANATECH Corporation, prepared a document that provided the missing analysis procedure and details. ANATECH informed the NRC inspection team that the analyst had not done a sensitivity analysis to model mesh refinement for the AIA project except for Case 2B for the spent fuel pool analysis for which mesh refinement was used to address an anomaly. ANATECH explained that the meshing refinement used in the analysis was based on the analysts' experience for the applicable class of problems.

On the basis of this review, the NRC inspection team verified that the AIA structural damage analysis adequately considered design inputs, analysis parameters and assumptions, computer codes, methods used for structural analyses and results. The inspection team also verified that the applicant had adequately analyzed the effects of and damage to structures resulting from global loading arising from an aircraft impact.

- The NRC inspection team reviewed the TeraGrande computer code used in the structural analysis for AIA and verified that the applicant had validated and verified the code for the applicable class of problems assessed and had adequately documented the validation and verification.

- The NRC inspection team reviewed the scenarios assessed to determine if the applicant considered the appropriate scenarios in its assessment and had adequately conducted the assessments. As part of its review, the NRC inspection team determined that the analyses of the aircraft impact on the refueling floor shield plugs did not consider the potential effects of the aircraft impact on the gantry crane.

  The applicant stated that it had excluded the gantry crane from the AIA because of its stored location while the plant is operating. In addition, the applicant argued that NEI 07-13 discusses the effects from impact on the polar crane but was silent on the gantry crane. The NRC recognized that NEI 07-13 does not include a discussion on the gantry cranes and that it is silent on many other areas that were included by the applicant in its AIA. The NRC inspection team explained that the intent of NEI 07-13 is to provide general guidance along with some detailed guidance for unique or more complex applications that were identified by the industry or the NRC as areas needing more guidance. NEI 07-13 was not intended to be an all inclusive instruction and, the fact that NEI 07-13 is silent in some areas cannot be considered justification for excluding those areas from the scope of the AIA.

  Excluding the potential interaction between the aircraft and any major component such as the gantry crane can overlook significant potential structural damage resulting in less than a realistic analysis. The applicant acknowledged the NRC inspection team's concern and committed to reassessing the refueling floor scenarios to include the gantry crane. The

failure to include the gantry crane is another example of a deficiency in the assessment that contributed to Violation 05200001/2010-202-1 that cites STPNOC for not using realistic analyses in its AIA as required by 10 CFR 50.150(a)(1).

- The NRC inspection team reviewed a sample of structural damage analyses to determine if the applicant properly applied the NRC-supplied forcing function in its AIA. The inspection team verified that the applicant properly applied the NRC-supplied forcing function in its structural damage analyses.

- The NRC inspection team reviewed a sample of structural damage analyses to determine if the applicant used the correct failure criteria and correctly interpreted them. As part of its review, the inspection team observed that the applicant conservatively excluded concrete aging in its analyses. The NRC inspection team also identified that Table II-2 of "Evaluation of Aircraft Impact on ABWR Plant Design for STP Project, Volume 2, Design Input Control," references material properties from American Society of Mechanical Engineers, Section 2, Part A, "Ferrous Materials." The inspection team initially determined that the code used in this portion of the assessment is not the correct industry Code for reinforcing rebar and A-36 structural steel and not consistent with the limiting strain specified in NEI 07-13 (Appendix B.1.2). The NRC inspection team identified a similar concern regarding Material A992 elongation values. The applicant explained that for the rebar, the elongation of the material (20%) was simply used to compute the slope of the hardening portion of the material. Once the rebar yields, however, the actual value of failure strain (5%) was used for the material in the analyses. The applicant also confirmed that material A992 has not been used in the AIA calculations. The NRC inspection team verified the information provided by the applicant and, therefore, considered these issues resolved.

The NRC inspection team reviewed the AIA to determine consistency with the design. On the basis of its limited review, the NRC inspection team identified a number of differences. For example, the AIA calculations for the aircraft impact on the SFP take credit for a specific liner thickness. The thickness of the SFP liner is not specified in the design. In addition, concrete strength and increased wall reinforcement, depending on location, required for the Reactor Building interior walls and barrier doors as credited in the AIA are not part of the design. The SFP liner thickness and increase in Reactor Building wall and barrier door concrete strength and reinforcement credited in STPNOC AIA are not identified and incorporated into the design and are further examples of deficiencies in the assessment contributing to Violation 05200001/2010-202-1 that cites STPNOC for crediting certain design features not identified in its design contrary to the requirements of 10 CFR 50.150(a)(1).

b.3 Containment structure and spent fuel pool specific impact assessment

The NRC inspection team reviewed the containment and spent fuel pool impact analyses to determine whether the applicant has met the sufficiency criteria in NEI

07-13, Section 2.5. The NRC inspection team reviewed the structural damage assessment as it relates to local loading on the containment structure and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- The applicant adequately documented and cross-checked the aircraft engine parameters used in the analysis against NRC-specified parameters.

- The applicant properly applied the various local loading formulas referenced in NEI 07-13, Subsection 2.1.2, to arrive at the degree of local damage.

- The applicant used the formulas cited in NEI 07-13 and approved by the NRC.

The NRC inspection team reviewed the structural damage assessment as it relates to global loading on the containment structure and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- The applicant effectively used and adequately documented the application of the force time-history analysis method and cross-checked it for its equivalency to the NRC-specified force time-history.

- The applicant had adequately documented the application of the missile-target interaction analysis method and cross-checked it for its equivalency to the NRC-specified force time-history.

- The missile-target interaction analysis method reasonably captured the mass distribution of the missile when a “reverse-engineering” approach was used to determine the missile-target interaction from the force-time history.

- For the application of the force time-history analysis method, the applicant properly used and adequately documented the NRC-specified spatial distribution of the impact force in the analyses.

The NRC inspection team reviewed a sample of documents for material characterization and failure criteria related to the structural damage assessment and verified that the following analysis activities were conducted:

- The material properties and the equations used to model the nonlinear behavior of both steel and reinforced concrete materials used in the analyses are consistent with the material properties and equations documented in NEI 07-13, Section 2.3, and are adequately documented.

- The applicant properly applied the dynamic increase factors specified in NEI 07-13, Subsection 2.3.1, for the various materials use in the analyses.

- The applicant properly applied the ductile failure strain limits specified in NEI 07-13, Subsection 2.3.2, for the various materials use in the analyses.

- The concrete structural failure criteria used in the analyses are appropriate and consistent with the criteria specified in NEI 07-13, Subsection 2.3.3, and are adequately documented.

- The applicant properly applied the material models specified in NEI 07-13, Subsection 2.3.4.

- The applicant properly applied and adequately documented the structural integrity failure criteria specified in NEI 07-13, Subsection 2.3.5.

The NRC inspection team reviewed NEI 07-13, Section 2.4, regarding the major assumptions applied to the containment structural analyses and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- The missile interaction analysis model properly assumed that the aircraft impact was perpendicular to the centerline of the containment.

- The missile interaction analysis model properly assumed takeoff weight such that the missile-interaction model is equivalent to the NRC-specified force time-history.

- Containment regions containing critical penetrations received an appropriate level of special consideration.

- Spent fuel pool analyses properly assumed that both the engine and the aircraft fuselage strike was perpendicular to and at the mid-point of the spent fuel pool wall.

- The applicant assessed potential aircraft impact at other locations that could result in greater consequences.

- The applicant did not take credit for fuel pool water inventory in its spent fuel pool analyses.

The NRC inspection team reviewed NEI 07-13, Section 2.5, regarding the sufficiency criteria applied to the containment structural analyses and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- The containment was concluded to remain intact, consistent with the sufficiency criteria of Section 2.5.1.

- The spent fuel pool was concluded to remain intact, consistent with the sufficiency criteria of Section 2.5.2.

- The applicant carried out and adequately documented the analysis for an aircraft impact below the spent fuel pool as specified in NEI 07-13.

b.4 Structural damage footprint assessment

The NRC inspection team reviewed the structural damage footprint analyses to determine whether or not the following items of interest related to the damage rule sets identified in NEI 07-134, Chapter 3, "Heat Removal Capability," have been met. The NRC inspection team reviewed the structural damage rule sets and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- Structures of concern that contain systems, structures, and components (SSCs) have been identified.

- A systematic evaluation of susceptible damage was conducted and adequately documented.

- Assumptions used to determine elevations of concern have been addressed and adequately documented.

- Each external face of each building exposed to a direct hit has been divided into two categories, containment structures and other reinforced concrete buildings; and has been analyzed and adequately documented.

Structural damage rule sets for containment structures were appropriately assessed.

The NRC inspection team reviewed the structural damage rule sets for reinforced concrete buildings for consistency with the guidance in NEI 07-13, Subsection 3.3.2 and Figure 3-10, and verified that the following activities were conducted in the analyses reviewed by the inspection team:

- Various impact points have been investigated consistent with the guidance in NEI 07-13 in order to define the damage footprint, and has been adequately documented.

- Structural damage rule sets regarding perforations were developed consistent with the guidance in NEI 07-13, Table 3-2 or Subsection 3.3.2.

- Shock damage was evaluated in the structural damage footprints and these evaluations have been adequately documented.

- The guidance in NEI 07-13, Table 3-3, was used to define the shock damage footprints and was adequately documented.

- Shock effects impacting seismic separation between buildings has been adequately assessed and documented.

c. Conclusions

The NRC inspection team found that with the exception of the contributing deficiencies to Violation 05200001/2010-202-1, the STPNOC structural damage assessment met the requirements of 10 CFR 50.150 and was conducted consistent with the guidance provided in NEI 07-13.

4. AIA Documentation and Quality Assessment

a. Inspection Scope

The NRC inspection team reviewed the STPNOC AIA documentation and quality plan as developed and implemented by the applicant and its primary contractor, Toshiba American Nuclear Engineering (TANE) as well as its subcontractors, WEC, ANATECH, and EE&R in the development of the AIA, to verify compliance with the requirements of 10 CFR 50.150. Specifically, the NRC inspection team reviewed the following documents and the implementation of the quality plan by ANATECH and EE&R:

- Appendix A, "Westinghouse Electric Company AIA Project Quality Plan," to the South Texas Project Units 3 & 4 (STP 3&4) Project Quality Plan (PQP), Revision 0, issued September 2009.

- ANATECH, "Evaluation of Aircraft Impact on Toshiba-WEC U.S.-ABWR Plant Design – Structural Response Analyses for DCD Amendment," Report No. ANA-08-0741, Revision 0, issued May 2009.

- Floyd, S., "Detailed Report Fuel Cooling Assessment Aircraft Impact Assessment for US-ABWR DCD Design," Revision 0, Report No. C177080001-8762, EE&R, dated May 29, 2009.

- Letter from Ken Canavan, (Electric Power Research Institute Senior Manager) to Mr. David A Christian, (Chair of the NEI Aircraft Impact Assessment Group) with regards to the results of the AIA peer evaluation, dated May 4, 2010.

In addition, the NRC inspection team reviewed the following purchase orders (POs) to determine the documentation and quality requirements imposed by STPNOC on its contractors and subcontractors:

- "Toshiba Corporation Procurement Specification for Support for the Preparation of a Combined License Application (COLA) Amendment for the South Texas Units 3 and 4 Project," Revision 0, dated June 2, 2008.

- PO 4500278022 dated September 11, 2008, from WEC to ANATECH Corporation requesting AIA related activities.

- PO 4500272562 dated July 15, 2008, from WEC to EE&R. requesting AIA related activities.

The NRC inspection team also reviewed a sample of ANATECH and EE&R reports used to document the performance, verification, and validation of the AIA.

b. Observations and Findings

b.1 Documentation

Section 5.1, "Documentation," of NEI 07-13 contains the industry guidance for documenting the AIA. With regards to documentation, NEI 07-13 states, in part, that each vendor should retain a file of the complete set of analyses performed in a manner consistent with the level of detail described in this methodology document. The documentation should be sufficiently complete and thorough to support an onsite review by the NRC to determine the overall adequacy of the assessment conducted.

During its review of the AIA documentation, the NRC inspection team determined that some of the information documented within the STPNOC AIA was incomplete and, in some cases, inconsistent with the information in the STPNOC DCA. The NRC inspectors identified the following examples of differences and omissions between the AIA and the STPNOC DCA:

- In terms of fire protection design features, the door to Room 512 is listed as a fire door in the STPNOC DCA and as a watertight door in the AIA.

The AIA documentation lacked structural details limiting the NRC inspection team's ability to effectively assess the applicable portions of the AIA The NRC inspection team was informed that the missing structural details were contained within a proprietary computer model. The inspection team reviewed a sample of the computer code for Cases 2A, 2B, and 2E and verified the adequacy of the structural details in each of these cases.

The NRC inspection team discussed the industry peer review with the applicant and determined that the review consisted of a presentation and a question and answer period. The NRC reviewed the industry peer review report and verified that it lacked technical substance and any reference to technical materials reviewed. The inspection team determined that the peer review lacked technical substance and that STPNOC oversight of the assessment development was inadequate to assure the AIA met the requirements of the rule.

b.2 Quality Requirements

Section 5 of NEI 07-13 states that the quality assurance standards and measures applied by an applicant must be able to establish the validity of the assessment and supporting calculations, and that the results must be document consistent with 10 CFR 50.150.

Appendix A, "Quality Program Elements" to the PQP for STP 3&4 identifies and defines the quality elements intended to meet the standards and measures

identified in NEI 07-13. Specifically, Appendix A defines the following three quality elements to be used in the development of the AIA: (1) identification of Inputs; (2) the performance and verification and validation (V&V) of assessment; and (3) documentation.

The NRC inspection team reviewed the ANATECH quality plan and related AIA documentation. The NRC inspection team verified that with the exception of those items identified throughout this inspection report, that the inputs and assumptions supporting the analyses were clearly identified in ANATECH Report No. ANA-08-0741. The inspection team also verified that ANATECH's independent reviewer verified that the inputs, assumptions, methodology, assessment results, and conclusions are consistent with the standards and measures in Appendix A of the PQP for STP 3&4.

The NRC inspection team reviewed the quality plan implemented by EE&R in the development of the heat removal analysis and determined that EE&R performed the initial analysis and WEC conducted the V&V consistent with Appendix A of the PQP for STP 3&4. The inspection team also reviewed the independent review conducted by WEC and verified that the inputs, assumptions, methodology, assessment results, and conclusions were consistent with Appendix A of the PQP for STP 3&4. The NRC inspection team reviewed EE&R Engineering Report No. C177080001-8762 and verified that all the inputs and assumptions were properly identified in the report. The inspection team also verified that WEC will be responsible for storing and controlling all the documentation generated as part of the AIA.

c. Conclusions

The NRC inspection team determined that the applicant has implemented the requisite quality assurance standards and measures to establish the validity of the AIA and supporting calculations. However, the team also identified certain deficiencies associated with the rigor of the peer review process as well as documentation errors that warrant additional scrutiny by the applicant. Corrective actions necessary to address these deficiencies should be factored into STPNOC's response to the NOV and will inform the NRC's decision to perform a follow-up inspection.

5. Entrance and Exit Meetings

On May 17, 2010, the NRC inspection team discussed the scope of the inspection with Mr. William Mookhoek, from STPNOC, and with the representatives from WEC, ANATECH, and EE&R. On May 21, 2010, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Scott Head, from STPNOC, and with the representatives from WEC, ANATECH, and EE&R. Attachment 2 to this report lists the entrance and exit meeting attendees.

ATTACHMENT 1

1. PERSONS CONTACTED

Name	Company/Employer	Position
Chandra, Subhash	Westinghouse	Engineering Lead
Dunham, Robert	ANATECH	President
Floyd, Steve	Erin Engineering	Heat Removal Analysis Lead
Greenwood, Donna	ANATECH	Support
Hynes, Fred	Westinghouse	Licensing
Heacock, Evan	STPNOC	STP Engineering Lead
Jain, Nimal	Westinghouse	System Analysis
James, Randy	ANATECH	Structural Analysis Lead
Mookhoek, William	STPNOC	STP Senior Licensing
Nilekani, Vijay	NEI	Industry Representative
Parker, Dan	ANATECH	Analyst
Puleo, Fred	STPNOC	STP Project Lead
Robles, Rosa	ANATECH	Support
Scheide, Dick	STPNOC	STP Inspection Lead
Veitch, Thomas	TANE	TANE PM
Wong, Frank	ANATECH	Analyst
Zhang, Liping	ANATECH	Analyst

ATTACHMENT 2

1. ENTRANCE/EXIT MEETING ATTENDEES

MAY-23-2010 18:53 P.002

NRC INSPECTION/AUDIT ATTENDANCE SHEET

REPORT #: 2010-202	DATE: 5/21/2010	☐ ENTRANCE	☒ EXIT

NAME (Print)	ORGANIZATION	TITLE	PHONE
Dick Scheide	STP Licensing	Lic. Eng.	
Subhash Chandra	Westinghouse	Proj. Manager	
Fred Hayes	Westinghouse	Principal Licensing Engineer	
Bill Mookhoek	STPNOC	Licensing Supervisor	
Evans Heacock	STPNOC	Design Eng. Lead	
Steve Floyd	ERIN	Executive Consultant	
Nirmal Jain	Westinghouse	Mgr. ABWR ENG Eop.	
Thomas P. Veitch	TANE	Specialist	
Fred Pileo	STPNOC	Lic. Engineer	
Randy James	Anatech	Principal Engineer	
Robert Dunham	Anatech	President	
Joe Rashid	Anatech	Chairman	
Robert Prato	US. NRC	Sr. Rx Ops Eng.	
David Jeng	US. NRC	Sr. Structural Engr.	
Yamir Diaz	US NRC	Reac. Op. Eng	
Dennis Andrukat	US NRC	Fire Protection Eng.	
George Thomas	USNRC	Sr. Rx. Sy. Engr	
B. P. Jain	USNRC	Sr. Struct Engr	
Alex Brown	Sandia National Labs	Tech Staff	
Jose Guadalupe Argüello	Sandia Nat'l Labs	Principal Member of Tech Staff	
Nanette Gilles	NRC	Senior Policy Analyst	
Mark Caruso	NRC	Sr. Risk Policy Analyst	

STP AIA Entrance Meeting
5/17/2010

NAME	TITLE	AFFILIATION	PHONE
R Prato	Team Leader	US NRC	
Mark Caruso	Team Member	US NRC	
Dennis Andrukat	Team Member	US NRC	
BP Jain	Team Member	US NRC	
David Jeng	Team Member	US NRC	
Yamir Diaz-Castillo	Team Member	US NRC	
Dr. Arguello	Team Member	US NRC	
Dr. Brown	Team Member	US NRC	
Nannette Gilles	Team Member	US NRC	
Paul Kallan	Team Member	US NRC	
Fred Hayes	Principal licensing Engr.	Westinghouse	
Bill Mookhoek	STP Licensing	STP	
Bob Dunham	ANATECH President + SAI Prog. Manager	ANATECH	
RANDY JAMES	ANATECH Project Manager	ANATECH	
Stephen Floyd	ERIN Consultant	ERIN	
Evan HEACOCK	STP Design Eng Lead	STPNOC	
Tom Veitch	TANE ~~and~~ Licensing	TANE	
SUBHASH CHANDRA	WEC, TECH. LEAD	WEC	
Nirmal Jain	WEC, System Anysis	WEC	
Joe Rashid	Executive and Technical Director	ANATECH	
Fred Polleo	STP Licensing	STP	
Bob Nickell	EPRI Expert Panel	EPRI	
Dick Scheide	STP LICENSING	STP	
VIJAY HILEKARI	NEI SR PROJECT MANAGER-SECURITY	NEI	

TOTAL P.003

2. Inspection Procedures Used

Inspection Procedure 37804, “Aircraft Impact Assessment”

3. List Of Items Opened, Closed, And Discussed

The NRC has not performed any previous inspections of the STPNOC AIA.

The NRC found the following items during this inspection:

Item Number	Status	Type	Description
05200001/2010-202-1	Open	NOV	10 CFR 50.150(a)(1)