Elkhiamy, Sarah

From:	Pinson, Brandon B
Sent:	Thursday, January 28, 2016 2:16 PM
To:	R1ALLEGATION RESOURCE
Cc:	WARNEK, NICOLE S; Schussler, Jason E; DENTEL, GLENN T; DEFRANCISCO, ANNE E
Subject:	**Sensitive Allegation Material** RI-2015-A-0074 RAC control room habitability writeup
Attachments:	IP3 CR habitability.docx

** Updated to remove specific distances. **

Attached is the technical response regarding the questions surrounding control room habitability and susceptibility to methane in-leakage. The document was prepared by the region and edited by individuals from NRR's Plant Systems Branch

Brandon Pinson
RI, DRP, Branch 2
(610)-337-5390

Statement from CI on control room habitability at IP3 as it relates to the natural gas pipelines:

There is one additional issue from another source, related to these gas lines and that concerns the protection of the control and switchgear rooms located about 380 feet from the existing gas lines.

NRC regulations (10 CFR 50, Appendix R and Appendix A, Criterion 3, 4, and 19) and guidance (Regulatory Guides 1.78, 1.91 and 1.1962) require protection from internal and external events that could impact the operability of the control room and other SSCs. My review of the Current Licensing Basis (CLB) as defined in 10 CFR 54.3 indicates there is no protection for the control room and other vital structures in the event of a methane gas leak from the existing 64-year-old gas transmission lines. A small leak could totally disable the control room and its personnel and vital SSCs necessary to safely shut down the reactor. The CLB documents discuss the potential of chlorine gas and other toxic gasses located more than a mile from the control room but totally ignore the potential for a gas leak that operates continuously within 380 feet of the control room.

Some of these analyses, still part of the CLB, assume the presence of non-existent automatic gas line isolation valves. Should a leak occur and undetected methane concentrations enter the control room, this could disable both the controls and operation personnel and have a severe impact on the on the ability to safely shut down the plant.

NRC Response:

The staff has evaluated the potential for natural gas to disable operators in the control room and concluded that the potential is negligible. The NRC guidance contained in Regulatory Guide 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release," Revision 1 (ML013100014), specifies considerations in evaluating the control room habitability, including the distance from the control room, the quantity of the hazardous chemical, the atmospheric dispersion of the release, the toxicity, the ability to detect the release, and the isolation of the control room. Although the pipeline is relatively close and could release a large quantity of natural gas, the gas would be unlikely to reach the control room; if it did reach the control room, the natural gas has low toxicity; and the gas is detectable by its odor at low concentrations, which would allow operators to isolate the control room.

The natural gas would be unlikely to reach the control room intake because if its low density and the distance separating the pipeline from the control room air intake. The density of natural gas (methane) is significantly less than the density of air at the same temperature, which will allow for natural gas to quickly dissipate upward into the atmosphere if a leak was to occur. The distance between the control room air intake at Indian Point Unit 3 (IP3) and the gas pipelines is greater than 500ft, providing an additional barrier as the gas would have to travel a significant distance at a relatively low elevation in order to pose a risk of entering the control room air intake.

If natural gas were to accumulate, it is not toxic at low concentrations, unlike other compounds of concern. Rather, it is hazardous due to its explosive potential above concentrations of a few percent by volume and the potential to displace oxygen at even higher concentrations. Therefore, the natural gas would have to reach the control room with little dilution to be hazardous, which is not credible.

Finally, the control room ventilation system provides for isolation of the control room air, if necessary. The control room air intake and the control room proper have, as required by NRC regulations, toxic gas monitors that are capable of detecting gases such as chlorine, anhydrous ammonia, and, indirectly, carbon dioxide. The oxygen detectors that are used to indirectly measure carbon dioxide levels could also serve to alert operators if high levels of natural gas were to enter the control room air intake or control room atmosphere and displace the oxygen present. The control room contains alarms that would alert operators if these toxic gases were detected, there was equipment trouble, or on a loss of power. Additionally, the natural gas that is transported through the gas pipelines at IP3 is odorized with sulfur containing compounds (mercaptans) that would allow detection of the natural gas by personnel on site, as well as operators in the control room, at low concentrations. This would allow operators to place the control room ventilation in a 100% recirculation mode that would prevent further ingress of outside air.

Elkhiamy, Sarah

From:	Pickett, Douglas
Sent:	Thursday, October 22, 2015 8:59 AM
To:	Mccoppin, Michael; Tammara, Seshagiri
Cc:	Miller, Chris; Beasley, Benjamin; Dentel, Glenn; Pinson, Brandon; Stuchell, Sheldon; Banic, Merrilee; Cylkowski, David; Beaulieu, David; Carpenter, Robert; Wray, John; Thompson, William; Setzer, Thomas; Burritt, Arthur; Draxton, Mark; Pinson, Brandon
Subject:	Region I Requests Assistance RE: Indian Point Gas Pipelines
Attachments:	**Sensitive Allegations Information** IP gas pipeline report for R1-2015-A-0074; **Sensitive Allegations Material** R1-2015-A-0074 RFI response

Mike/Rao –

Entergy's 2008 analysis of the existing gas pipelines concluded that a rupture of both pipelines would result in heat flux values exceeding our threshold value of 12.6 kw/m^2 in portions of the Unit 3 protected area. Paul Blanch's allegation included this aspect and Region I issued a Request for Information to the licensee to address this. The bulk of Entergy's response is attached. The remainder, plant procedures, is available and is currently on CD with the Region.

Region I has requested that we review the attached and let them know if we agree with their approach and whether we consider their approach appropriate and conservative. Are you able to assist us (again)?

Thanks - Doug

Douglas V. Pickett, Senior Project Manager
Indian Point Nuclear Generating Unit Nos. 2 & 3
James A FitzPatrick Nuclear Power Plant
Douglas.Pickett@nrc.gov
301-415-1364

Bearde, Diane

From:	R1ALLEGATION RESOURCE
Sent:	Thursday, December 10, 2015 3:44 PM
To:	Warnek, Nicole; Crisden, Cherie; McLaughlin, Marjorie; Bearde, Diane; Bolger, Allyce; Galbreath, Stephanie
Subject:	FW: 2015-a-0074 - ip pipeline - allegation sensitive

---

From: Bickett, Brice
Sent: Thursday, December 10, 2015 3:44:16 PM (UTC-05:00) Eastern Time (US & Canada)
To: R1ALLEGATION RESOURCE
Subject: 2015-a-0074 - ip pipeline - allegation sensitive

Mike did concur – I owe him one response though – he asked if we could acknowledge (in a one-liner) about the conservatisms built into our independent review of the issue (i.e. conservative assumptions in the ALOHA model or the scenario to even begin the model). I promised to review the NRR response/analysis to see if they indicated that in their response to Glenn/Branch 2 before I would be comfortable in that statement, even though it is highly likely true.

We can hit that head on Monday.

Brice

Bearde, Diane

From: R1ALLEGATION RESOURCE
Sent: Thursday, December 10, 2015 4:51 PM
To: Warnek, Nicole; Crisden, Cherie; McLaughlin, Marjorie; Bearde, Diane; Bolger, Allyce; Galbreath, Stephanie
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

---

From: Bickett, Brice
Sent: Thursday, December 10, 2015 4:50:56 PM (UTC-05:00) Eastern Time (US & Canada)
To: R1ALLEGATION RESOURCE
Cc: Dentel, Glenn
Subject: Re: RE: existing pipeline hazard evaluation write-up for IPEC allegation

I actually think we can at least highlight that our independent review was based on conservative assumptions and approach since rao says that in the intro.

Will see how to implement minor noodles to capture on Monday And that would satisfy mike

On: 10 December 2015 15:42, "R1ALLEGATION RESOURCE" <R1ALLEGATION.RESOURCE@nrc.gov> wrote:

From: Dentel, Glenn
Sent: Thursday, December 10, 2015 3:42:46 PM (UTC-05:00) Eastern Time (US & Canada)
To: R1ALLEGATION RESOURCE
Cc: Bickett, Brice
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Glenn Dentel
Branch Chief responsible for oversight of Indian Point and FitzPatrick
610-337-5233 (w)

From: McCoppin, Michael
Sent: Thursday, December 03, 2015 3:54 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Folks,

Some minor edits as discussed between Glenn, Rao, and I today. Please feel free to make any editorial edits as you see fit.

Regards,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

Office of New Reactors
United States Nuclear Regulatory Commission

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Office: T7-F18
Ph: 301.415.6533
Cell: (b)(6)
FAX: 301.415.5399
Email: michael.mccoppin@nrc.gov

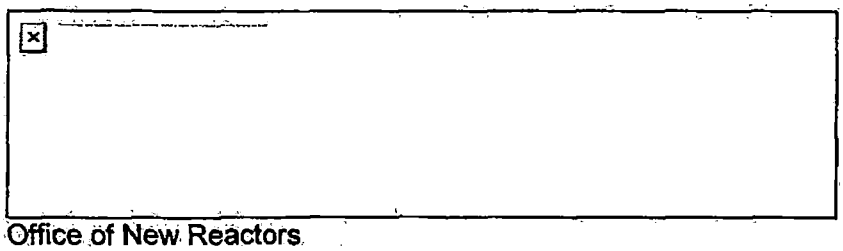
From: McCoppin, Michael
Sent: Tuesday, December 01, 2015 2:55 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Importance: High

Rao...my edits are included.

Thanks,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)



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FAX: 301.415.5399
Email: michael.mccoppin@nrc.gov

Warnek, Nicole

From: R1ALLEGATION RESOURCE
Sent: Thursday, December 10, 2015 3:43 PM
To: Bickett, Brice; Warnek, Nicole; Crisden, Cherie; McLaughlin, Marjorie; Bearde, Diane; Bolger, Allyce; Galbreath, Stephanie
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Attachments: Indian Pt-Rao's Allegation_analysis_writeup (w corrections 12-3-15) (00000002).docx; IPEC_exisiting_pipelines_impact_writeup_redac.pdf

---

From: Dentel, Glenn
Sent: Thursday, December 10, 2015 3:42:41 PM (UTC-05:00) Eastern Time (US & Canada)
To: R1ALLEGATION RESOURCE
Cc: Bickett, Brice
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Glenn Dentel
Branch Chief responsible for oversight of Indian Point and FitzPatrick
610-337-5233 (w)

From: *Tammara, Seshagiri*
Sent: Monday, December 07, 2015 4:11 PM
To: McCoppin, Michael <Michael.McCoppin@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

All

I have run ALOHA with maximum operating pressure of 750 psia instead of 674 psia and the change in results are documented as follows:

With 674 psia the estimated distance to 1 psi is (b)(7)(F) and to 3 psi is (b)(7)(F)

With 750 psia the estimated distance to 1 psi is and to 3 psi is

With 674 psia the estimated distance to 31.5 kw/m^2, 12.6 kw/m^2, and 5 kw/m^2 respectively are (b)(7)(F) (b)(7)(F)

With 750 psia the estimated distance to 31.5 kw/m^2, 12.6 kw/m^2, and 5 kw/m^2 respectively are (b)(7)(F) (b)(7)(F)

Thanks,
Rao

From: *Tammara, Seshagiri*
Sent: Friday, December 04, 2015 9:27 AM
To: McCoppin, Michael <Michael.McCoppin@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Mike/Doug/Glen:

I am on (b)(6) from Dec.8, 2015 through Jan.18, 2016 and (b)(6) Mike attached and transmitted the above file yesterday. In case there is a FOIA request, I have identified in yellow/red the potential results that may be redacted, and attached that scanned file (.pdf) for your convenience and easy referral.

Thanks,
Rao

From: McCoppin, Michael
Sent: Thursday, December 03, 2015 3:54 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Folks,

Some minor edits as discussed between Glenn, Rao, and I today. Please feel free to make any editorial edits as you see fit.

Regards,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

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FAX: 301.415.5399
Email: michael.mccoppin@nrc.gov

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Sent: Tuesday, December 01, 2015 2:55 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Importance: High

Rao...my edits are included.

Thanks,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
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Email: michael.mccoppin@nrc.gov

Confirmatory Analysis of Allegation Concern Evaluation
Of
Existing Pipelines Rupture Impact
At Indian Point Energy Center (IPEC)

INTRODUCTION

The licensee, Entergy, provided a response to NRC Request for Information (RI-2015-A-0074). As a part of the staff's review and evaluation of the response and associated attachment and enclosure, the NRC staff performed independent confirmatory calculations to ascertain the reasonability of approach, assumptions and methodology that Entergy used in their evaluation of consequences for the consideration of resolving the concerns raised in this RI. The staff's confirmatory calculations include the determination of the distance to 1 psi overpressure due to potential release of natural gas and explosion at the source of release, due to vapor cloud explosion, and distance to potential heat flux of 12.6 kw/m^2 due to release of gas as a jet fire.

SUMMARY OF EVALUATION

Entergy evaluated the potential hazards to safety-related structures, systems, and components (SSCs) and also SSCs important to safety (SSC ITS) using the BREEZE computer model with reasonable approach and assumptions. The staff performed independent confirmatory calculations with conservative assumptions and rationale using RG 1.91 methodology for source explosion and also used the ALOHA computer model for vapor plume explosion. The staff used the ALOHA model to perform the confirmatory calculations to determine:

1) Distance to 1 psi overpressure due to release and potential at source (at pipe rupture),
2) Distance to 1 psi overpressure due to delayed vapor cloud explosion,
3) Distance to heat flux of 12.6 kw/m^2 from natural gas release as jet fire.

The staff's independent confirmatory calculation results are based on highly conservative assumption and rationale by modeling the gas release rate for the potential explosion at the source. The rupture of the pipeline is assumed to be located at the closest SSC. Since the pipeline is buried underground, an average release rate, as calculated using ALOHA to determine total amount of gas released over the time period to empty the pipeline, results in a calculated distance to 1 psi overpressure of (b)(7)(F) In general, the review criterion of 1 psi overpressure provides a margin to failure of safety related SSCs. The safety-related SSCs are designed to withstand overpressure of 3 psi or more without loss of their safety functions. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

The staff's analysis of the distance to overpressure of 1 psi due to a delayed vapor cloud explosion assumed congestion in the area of release. The results extend the 1 psi overpressure to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (to any SSCs). A sensitivity analysis, which,

more realistically, assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

Using the ALOHA model, the staff calculated that the thermal radiation level of 12.6 kW/m^2 would extend to a distance of (b)(7)(F)

Based on the results of the confirmatory analysis, the staff concludes that the safety related SSCs, as well as SSCs important to safety, would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusions.

TECHNICAL EVALUATION

The staff performed an independent confirmatory analysis based on the rupture of the existing 30-inch natural gas pipeline, which consists of about 6 miles of pipeline between isolation valves. The analysis assumed that a rupture of the natural gas pipeline may result in an unconfined explosion or jet flame at the source or in a delayed vapor cloud explosion downwind. For the assessment of an unconfined explosion, the staff used RG 1.91 methodology to calculate the minimum safe distance due to the source explosion. For the jet flame and delayed vapor cloud explosion, the staff used the ALOHA chemical release modeling computer code to determine the hazard impact distances to compare with the actual distances to SSCs related to safety or SSC ITS, in order to assess the impact potential. The ALOHA code is used to calculate the amount of methane released for the scenario considered, using conservative meteorological conditions consisting of an assumed wind speed of 1 m/s in the direction of the SSC, F stability, 25 deg. C ambient temperature, cloud cover of 0.5 and relative humidity of 50%. Open country ground roughness conditions modeling assumptions were chosen as being appropriate for the location.

Explosion

The ALOHA code model for an explosion scenario conservatively estimated the gas release from a pipe rupture at the closest location to an SSC by considering the length of pipeline to be 6 miles, with the rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. The calculation results give an estimated total methane release amount over time (to calculate the average release rate) based on the closure of the isolation valves following the rupture, assuming that the entire volume of gas in the pipeline section between the closed valves is being released.

Assuming the average release rate, and determining the TNT equivalent amount with a yield factor of 0.05 (WTNT) (equation given below), the minimum safe distance (d) to 1 psi overpressure is calculated by using RG 1.91 methodology as follows:

WTNT= (Mf * DHC * Y)/4500

where

WTNT= TNT equivalent Mass, kg
Mf = Mass of vapor, kg
DHC = Heat of combustion, kj/kg (50030)
Y = Yield Factor (0.05)
and
$d = 45 * (w)^{1/3}$
where
d= minimum safe distance (ft.) to 1 psi overpressure
w= TNT equivalent mass in pounds

As the pipeline is buried underground, an average rate of gas release based on total amount of gas released over the time period to empty the pipeline, as calculated using ALOHA is assumed. Using this average gas release rate, the distance to 1 psi overpressure was calculated to be (b)(7)(F) Generally the safety-related SSCs are designed to withstand overpressure of 3 psi or more. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F).

The staff's analysis of the distance to not exceed an overpressure of 1 psi due to delayed vapor cloud explosion assumed congestion in the area of release, which would represent dense forest or buildings which enhance gas accumulation due to potential confinement. The results extend the 1 psi overpressure distance to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (for any SSCs). These results are comparable to that of the licensee's analysis results. A sensitivity analysis, which more realistically assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

Jet Fire

The ALOHA code for jet fire scenarios was run conservatively for the pipe rupture at a location closest to an SSC by considering the length of the pipeline between isolation valves to be 6 miles, with rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. Methane is assumed to be released from the ruptured pipe as a flammable gas and is assumed to be burning. The ALOHA calculation resulted in a maximum burn rate as well as an estimated total amount burned over time, based on closure of the isolation valves following the rupture. Based on the assumption that the entire volume of gas in the pipeline section between the closed valves is being released, the distances to thermal radiation levels of 31.5 kW/m^2, 12.6 kW/m^2, and 5.0 kW/m^2 calculated by ALOHA are (b)(7)(F) respectively. A few safety related SSCs and SSCs important to safety may be impacted. These results are consistent with the licensee's analysis results.

CONCLUSION

Based on the results of the staff's independent confirmatory analysis, the staff concludes that the safety-related SSCs as well as SSCs important to safety would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusion. Although the licensee's pipeline hazard impact evaluation used different models, assumptions, and methodology than the staff used in its independent confirmatory analyses, the staff's results and conclusions are consistent with the licensee's results and conclusions. Therefore, the staff considers the licensee's hazard impact evaluation to be reasonable and acceptable.

Bearde, Diane

From: R1ALLEGATION RESOURCE
Sent: Thursday, December 10, 2015 3:43 PM
To: Bickett, Brice; Warnek, Nicole; Crisden, Cherie; McLaughlin, Marjorie; Bearde, Diane; Bolger, Allyce; Galbreath, Stephanie
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Attachments: Indian Pt-Rao's Allegation_analysis_writeup (w corrections 12-3-15) (00000002).docx

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From: Dentel, Glenn
Sent: Thursday, December 10, 2015 3:42:46 PM (UTC-05:00) Eastern Time (US & Canada)
To: R1ALLEGATION RESOURCE
Cc: Bickett, Brice
Subject: FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Glenn Dentel
Branch Chief responsible for oversight of Indian Point and FitzPatrick
610-337-5233 (w)

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Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Folks,

Some minor edits as discussed between Glenn, Rao, and I today. Please feel free to make any editorial edits as you see fit.

Regards,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

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Elkhiamy, Sarah

From: Newman, Garrett
Sent: Tuesday, August 25, 2015 10:29 AM
To: Krohn, Paul; R1ALLEGATION RESOURCE
Cc: Lorson, Raymond; Suber, Gregory; Brand, Javier; Burritt, Arthur; Setzer, Thomas; Rich, Sarah
Subject: RE: SENSITVE ALLEGATION INFORMATION - Indian Point Allegation regarding Old Gas Pipeline - Additional Info to Assist in Evaluating Licensee's RFI Response

The ductwork along containment is the plant vent. Its radiation monitor R-27 has flow transmitters located at a platform about halfway up; the sampling skid and detectors are inside the fan house below. R-27 is used for EALs and dose assessment.

From: Krohn, Paul
Sent: Monday, August 24, 2015 5:22 PM
To: R1ALLEGATION RESOURCE
Cc: Lorson, Raymond; Suber, Gregory; Brand, Javier; Burritt, Arthur; Setzer, Thomas; Rich, Sarah; Newman, Garrett
Subject: SENSITVE ALLEGATION INFORMATION - Indian Point Allegation regarding Old Gas Pipeline - Additional Info to Assist in Evaluating Licensee's RFI Response

Nicole and Jeff,

I was onsite last week at Indian Point for the last week of a CDBI inspection. Javier Brand and myself took the opportunity to look at the old IPEC gas pipeline relative to critical structures at IP3. I am at HQs on Monday but will provide a simplified sketch of some of the elevation differences for the allegation file when I return on Tuesday, 8/25.

We should use this input in evaluating the adequacy of Entergy's response to our RFI. Items to consider:

- IP3 EDG exhaust damper actuators for all 3 EDGs have some exposure to heat flux. The exhaust damper actuators, however, are inside the louvers so some additional protection from heat flux may be justified. In any case, the licensee should discuss the exposure of the IP3 EDG exhaust damper actuators to heat flux.

- Unit 3 has some ducting on the exterior of primary containment. It runs from the base of containment to the apex. Not sure what is inside. It could be primary containment vent controls, rad instrumentation, etc. IPEC should address the contents of the ducting for any safety-related. EOP, PAR, or post-accident functions.

- Unit 3 main power output lines (all 3 phases) will be exposed to the heat flux. IPEC should evaluate if this affects the current carrying capacity of the power transmission lines (i.e., affects ampacity). If this is the case, the potential to trip Unit 3 on overcurrent or some other protective electrical function should be evaluated.

- Impact on security fence detection equipment should be evaluated.

- The warehouse is within ~100 feet of old gas pipeline. Contents of warehouse should be evaluated relative to the ability of Unit 3 to get to safe shutdown. Namely, does the warehouse contain any equipment (hoses, chargers, etc.) that IP3 needs to get to safe shutdown? If the warehouse does contain such equipment, it will likely be lost during an old pipeline conflagration event.

- Fire diesel building (which is cinder block construction) and two fire tanks are exposed to heat flux. These fire structures are located near the Unit 3 RWST. Effect of site's firefighting capability should be evaluated.

Regarding the Unit 3 RWST level instruments, these instruments have a safety-related function during a LOCA to help operations transition from the injection to the recirculation phase of an accident (manual actions at IP3). It appears that the RWST level instruments are shielded by ~5 feet of an adjacent concrete structure from direct line-of-sight, heat flux from the point of origin of the gas pipeline (i.e., the adjacent concrete building's roof is about 5 feet higher than the RWST level instruments).

However, what is uncertain is the height of the gas flame (like a center of gravity concept) and if this allows more of a direct heat flux on the RWST level instruments (see drawing). Also, the level instrument enclosure is rotated about 30 degrees off from a direct heat flux azimuth.

Again, the purpose of this email to file is to ensure we get a quality RFI response from IPEC. Please let Javier or myself know if you have any questions.

Paul

Elkhiamy, Sarah

From: LORSON, RAYMOND K
Sent: Wednesday, June 08, 2016 12:48 PM
To: HAAGENSEN, BRIAN C
Cc: LEW, DAVID C; DENTEL, GLENN T; Pickett, Douglas V; NEWMAN, GARRETT A; RICH, SARAH C
Subject: Re: Pls call me ASAP

I am not aware of any inspection or analysis where we looke at survivability of the flex building g. May be addressed in our upcoming see on this tand subject to future inspection

From: Haagensen, Brian
Sent: Wednesday, June 8, 2016 11:23:45 AM
To: Haagensen, Brian
Cc: Lew, David; Dentel, Glenn; Lorson, Raymond; Pickett, Douglas; Newman, Garrett; Rich, Sarah
Subject: RE: Pls call me ASAP

I just spoke with Brandon Pinson and Joe Schoppy and they do not recall any inspection activity or other analysis that looked at the impact of a gas explosion on the Flex Equipment Storage Building.

I have reached out to Entergy to get their input on this question.

If you have any other information relevant to this question please get this to Dave Lew ASAP. He needs this information (if possible) prior to the AAM this evening.

The question was:

'If a gas pipeline (old pipeline or new pipeline) explosion occurred, would the Flex Equipment Building survive the event?'

Brian

From: Haagensen, Brian
Sent: Wednesday, June 08, 2016 11:09 AM
To: Floyd, Niklas <Niklas.Floyd@nrc.gov>
Subject: FW: Pls call me ASAP

Nik,

Please call me ASAP regarding the email below.

From: Haagensen, Brian
Sent: Wednesday, June 08, 2016 11:01 AM
To: Schoppy, Joseph <Joseph.Schoppy@nrc.gov>
Subject: *Pls call me ASAP*

Joe,

During the morning welcome session at IPEC, Dave Lew had questions regarding an inspection he said you did on the impact of a gas pipeline explosion on the IPEC Flex Equipment Storage Building. Please call me ASAP today if you have a moment.

Dave stated that somebody (he thought it was you) had looked at the analysis for the pipeline explosion and determined that the Flex Building would not survive the explosion. He could not recall if this was an explosion from the new line – the old line or both.

Brian C. Haagensen
Senior Resident Inspector
Indian Point Energy Center
(914) 739-9360 (Office)
(b)(6) (Cell)

Elkhiamy, Sarah

From:	HAAGENSEN, BRIAN C
Sent:	Monday, June 06, 2016 12:46 PM
To:	RICH, SARAH C; NEWMAN, GARRETT A
Subject:	FW: Latest Revision of Slides for the Indian Point Webinar
Attachments:	IndianPointMediaBriefing 6-6-2016_Rev3.pptx

FYI

From: Floyd, Niklas
Sent: Monday, June 06, 2016 11:26 AM
To: Lew, David <David.Lew@nrc.gov>; Sheehan, Neil <Neil.Sheehan@nrc.gov>; Screnci, Diane <Diane.Screnci@nrc.gov>; Klukan, Brett <Brett.Klukan@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Gray, Mel <Mel.Gray@nrc.gov>; McHale, John <John.McHale@nrc.gov>; McCoppin, Michael <Michael.McCoppin@nrc.gov>; Noggle, James <James.Noggle@nrc.gov>; Lorson, Raymond <Raymond.Lorson@nrc.gov>
Cc: Tifft, Doug <Doug.Tifft@nrc.gov>; McNamara, Nancy <Nancy.McNamara@nrc.gov>; Haagensen, Brian <Brian.Haagensen@nrc.gov>
Subject: Latest Revision of Slides for the Indian Point Webinar

Attached is Revision 3 (most recent version), which includes comments from Dave and Jack.

If you have any other minor changes to make, then please email Neil or myself as soon as possible, so that we can incorporate them into the presentation before the webinar.

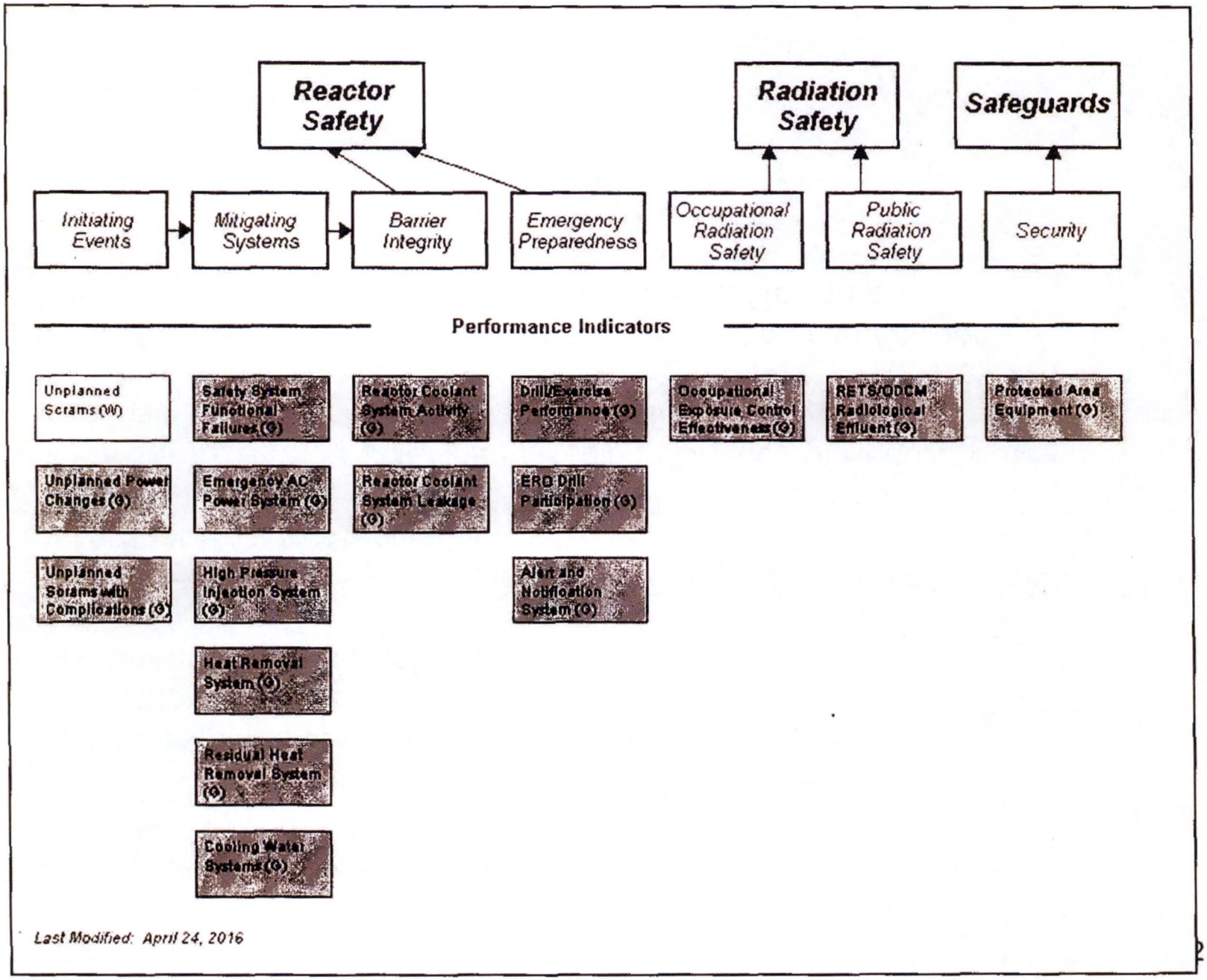
Thank you,

Niklas Floyd
Reactor Inspector
Division of Reactor Safety
USNRC Region I
(610) 337-5282

Media Briefing on Recent Issues at Indian Point Nuclear Plant

U.S. Nuclear Regulatory Commission

June 6, 2016


Reactor Safety
Radiation Safety
Safeguards
Initiating Events
Mitigating Systems
Barrier Integrity
Emergency Preparedness
Occupational Radiation Safety
Public Radiation Safety
Security
Performance Indicators
Unplanned Scrams (W)
Safety System Functional Failures (G)
Reactor Coolant System Activity (G)
Drill/Exercise Performance (G)
Occupational Exposure Control Effectiveness (G)
RETS/ODCM Radiological Effluent (G)
Protected Area Equipment (G)
Unplanned Power Changes (G)
Emergency AC Power System (G)
Reactor Coolant System Leakage (G)
ERO Drill Participation (G)
Unplanned Scrams with Complications (G)
High Pressure Injection System (G)
Alert and Notification System (G)
Heat Removal System (G)
Residual Heat Removal System (G)
Cooling Water Systems (G)
Last Modified: April 24, 2016

NRC PARTICIPANTS

David Lew, NRC Region I Deputy Administrator

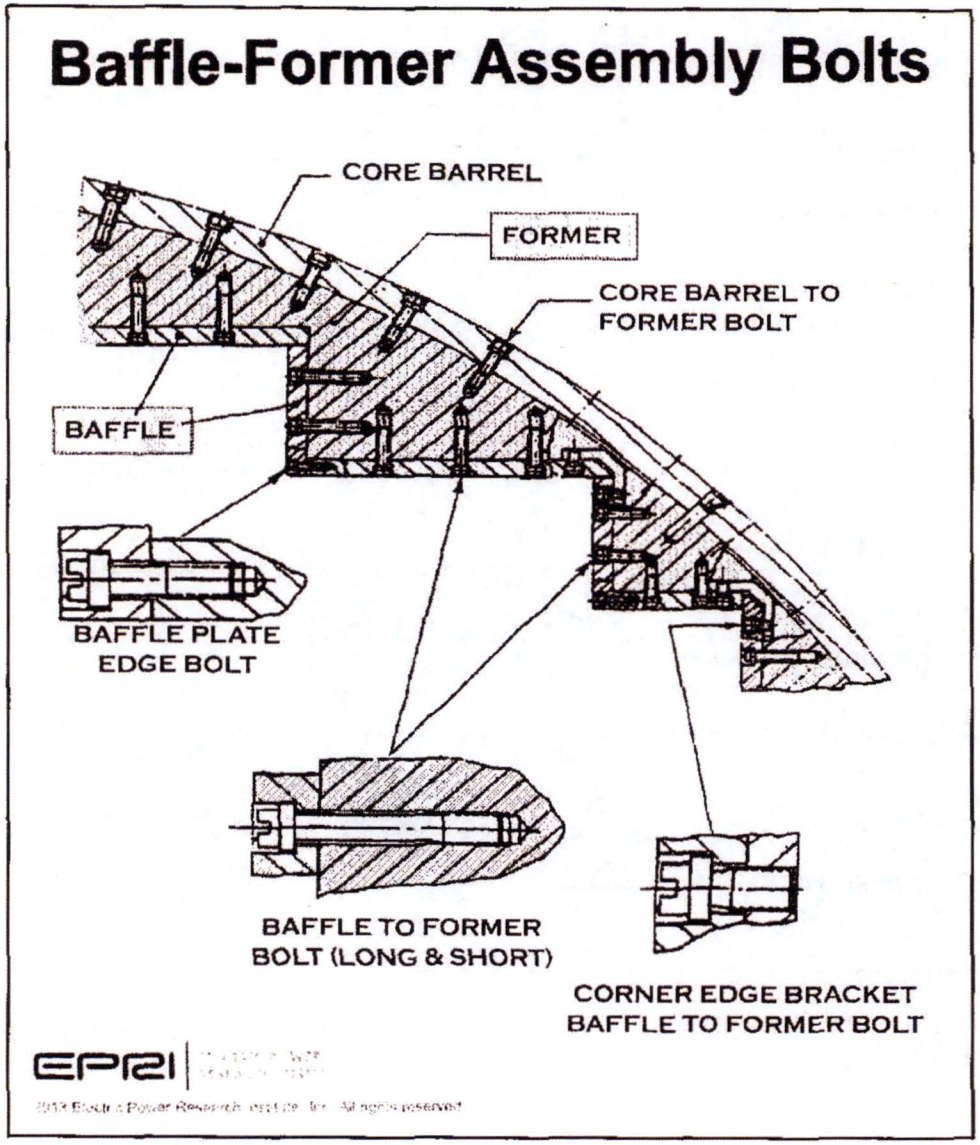
Neil Sheehan, NRC Public Affairs Officer, Region I

Jack McHale, Chief of the Vessels & Internals Integrity Branch, NRC's Office of Nuclear Reactor Regulation

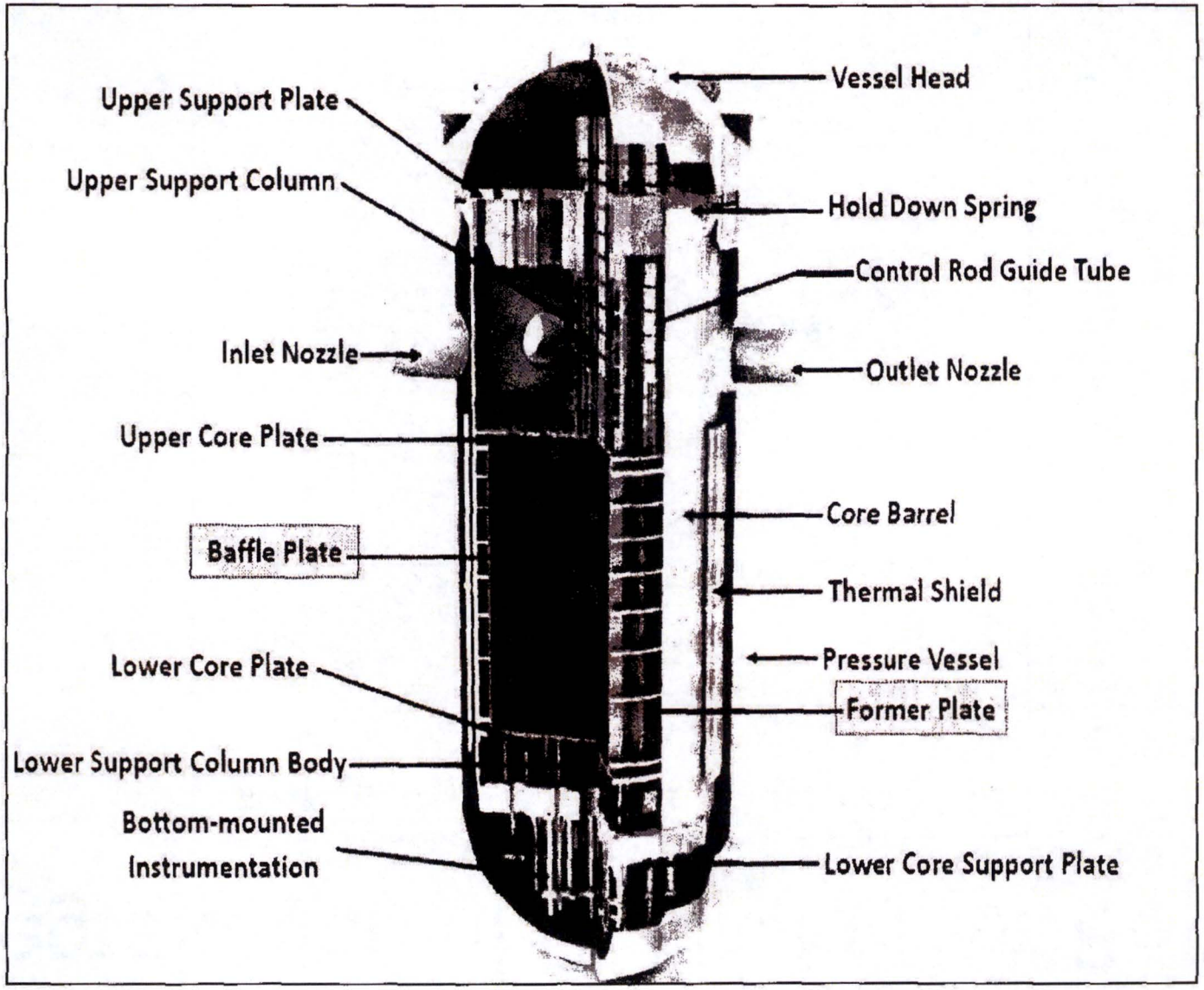
Jim Noggle, Branch Chief in the Region I Division of Reactor Safety responsible for radiological safety inspections

Mike McCoppin, Chief of the Radiation Protection and Accident Consequences Branch in NRC's Office of New Reactors

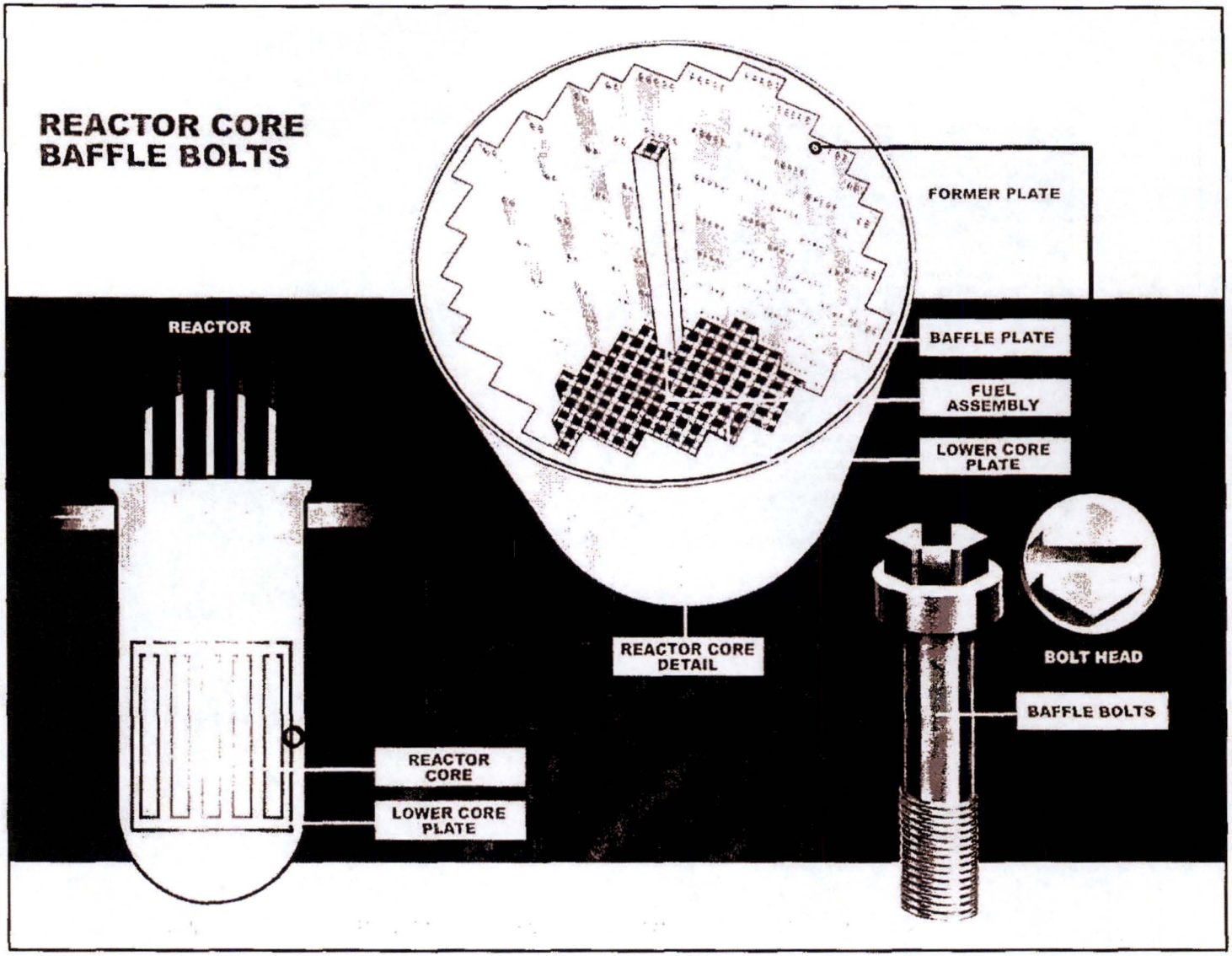
Degradation of Baffle-former Bolts



Degradation of Bolts (cont'd.)

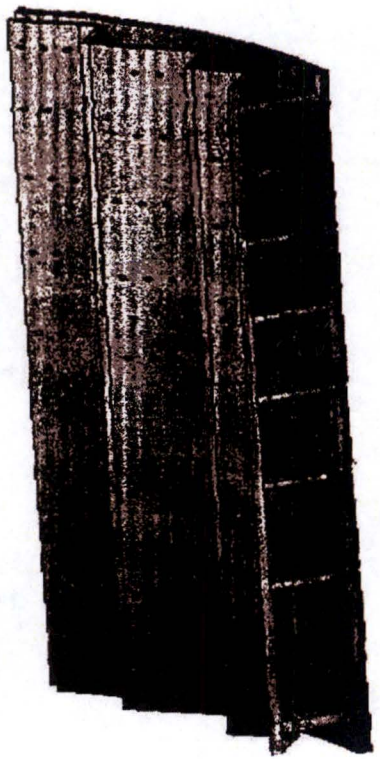


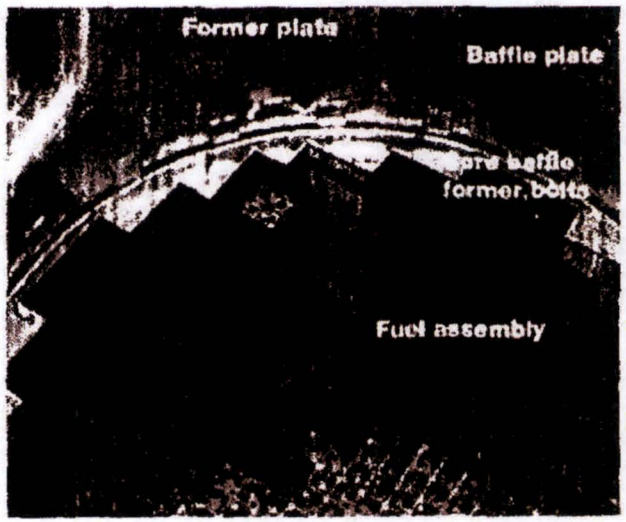
Degradation of Bolts (cont'd.)



Degradation of Bolts (cont'd.)

Baffle High Fluence Edge Seams/Edge Bolts



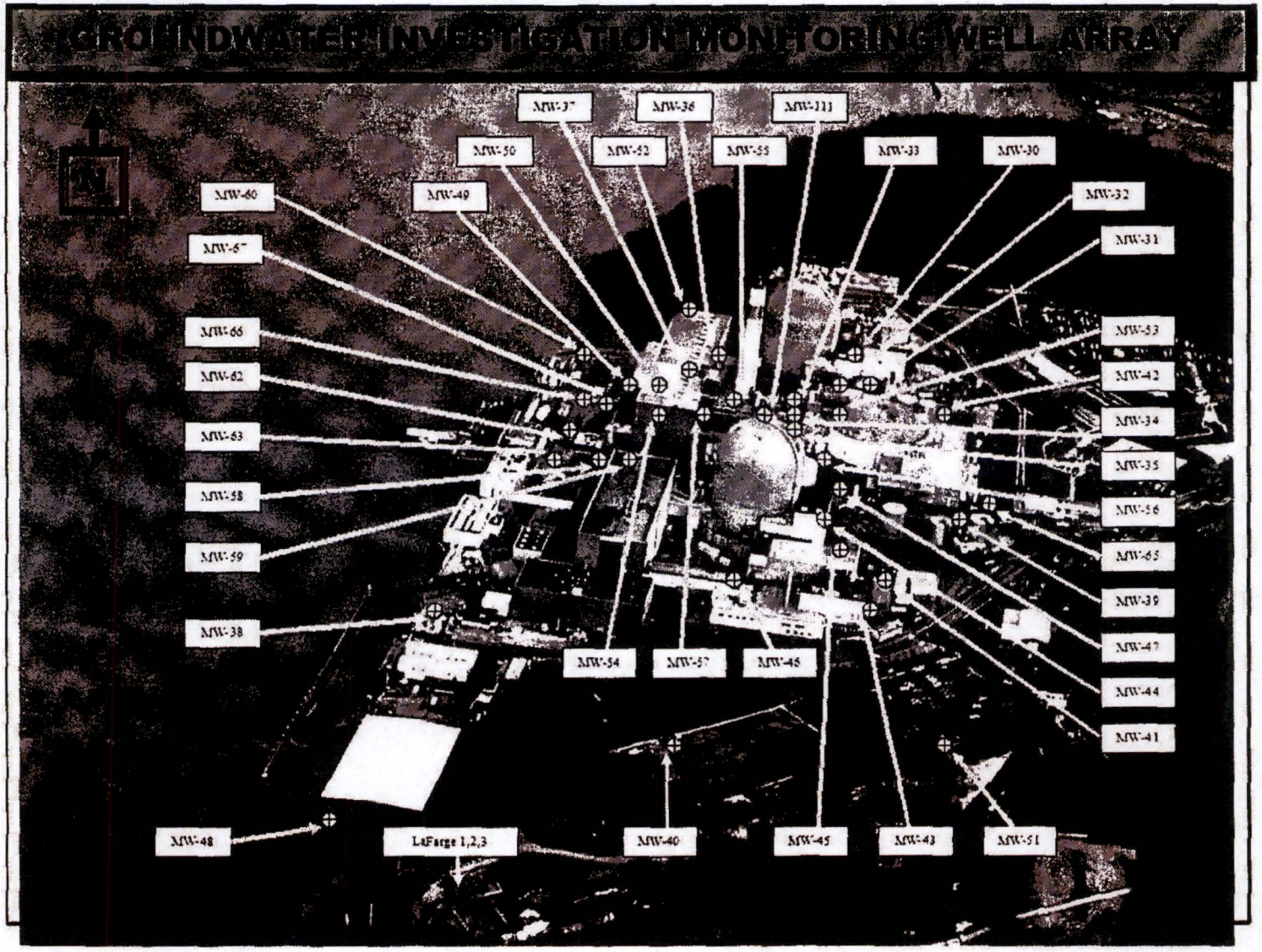


EPRI

Summary of Bolt Degradation

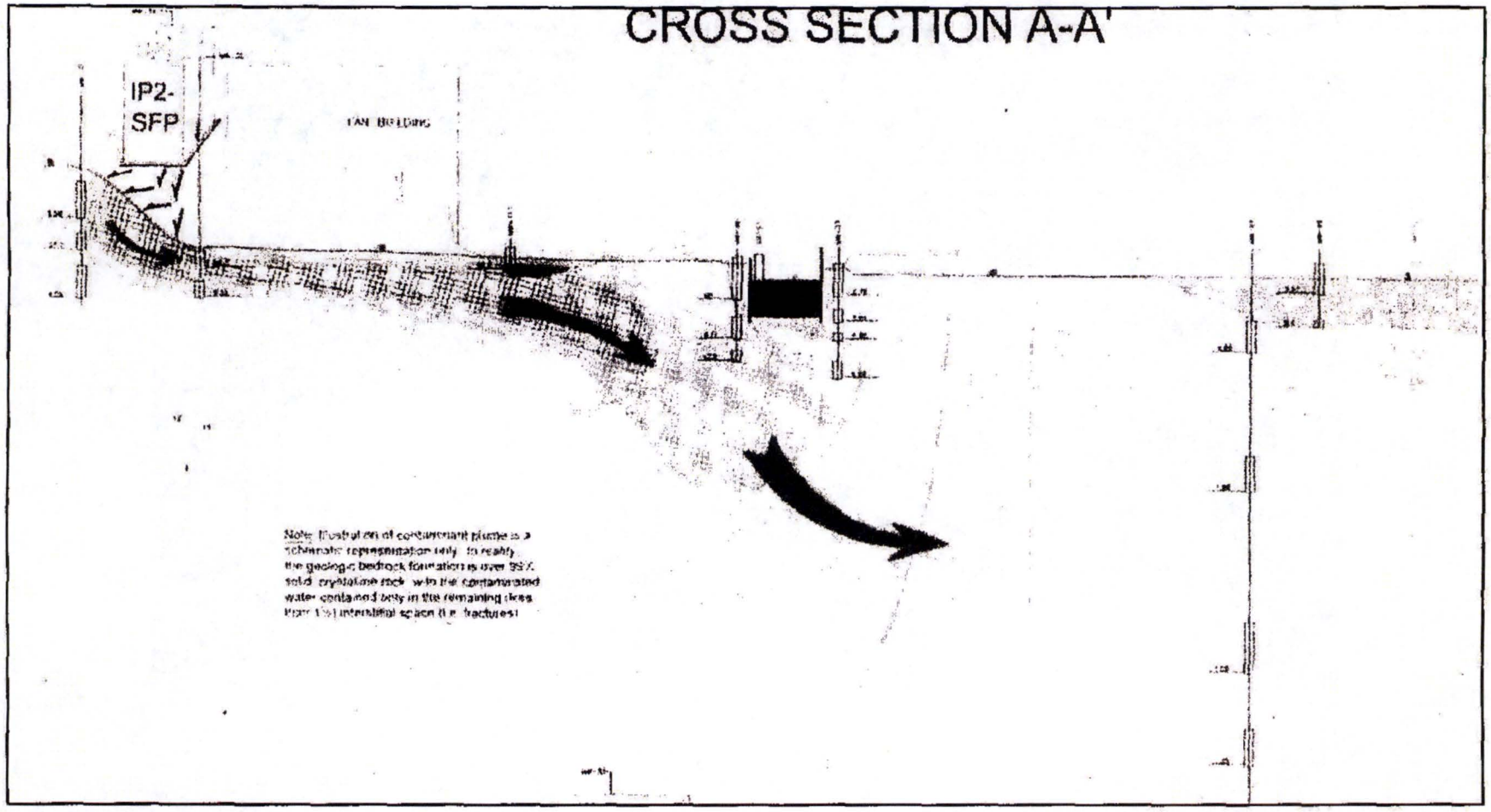
- The degraded bolts were identified through required inspections.
- Unit 2 is safe to restart based on bolt replacements and supporting analyses.
- There are no immediate safety concerns with the current operation of Unit 3.

Indian Point Groundwater Contamination



Indian Point Groundwater Contamination (Cont'd.)

Indian Point Groundwater Contamination (Cont'd.)



Health risks of tritium

- From the EPA fact sheet on tritium:

"As with all ionizing radiation, exposure to tritium increases the risk of developing cancer. However, because it emits very low energy radiation and leaves the body relatively quickly, for a given amount of activity ingested, tritium is one of the least dangerous radionuclides."

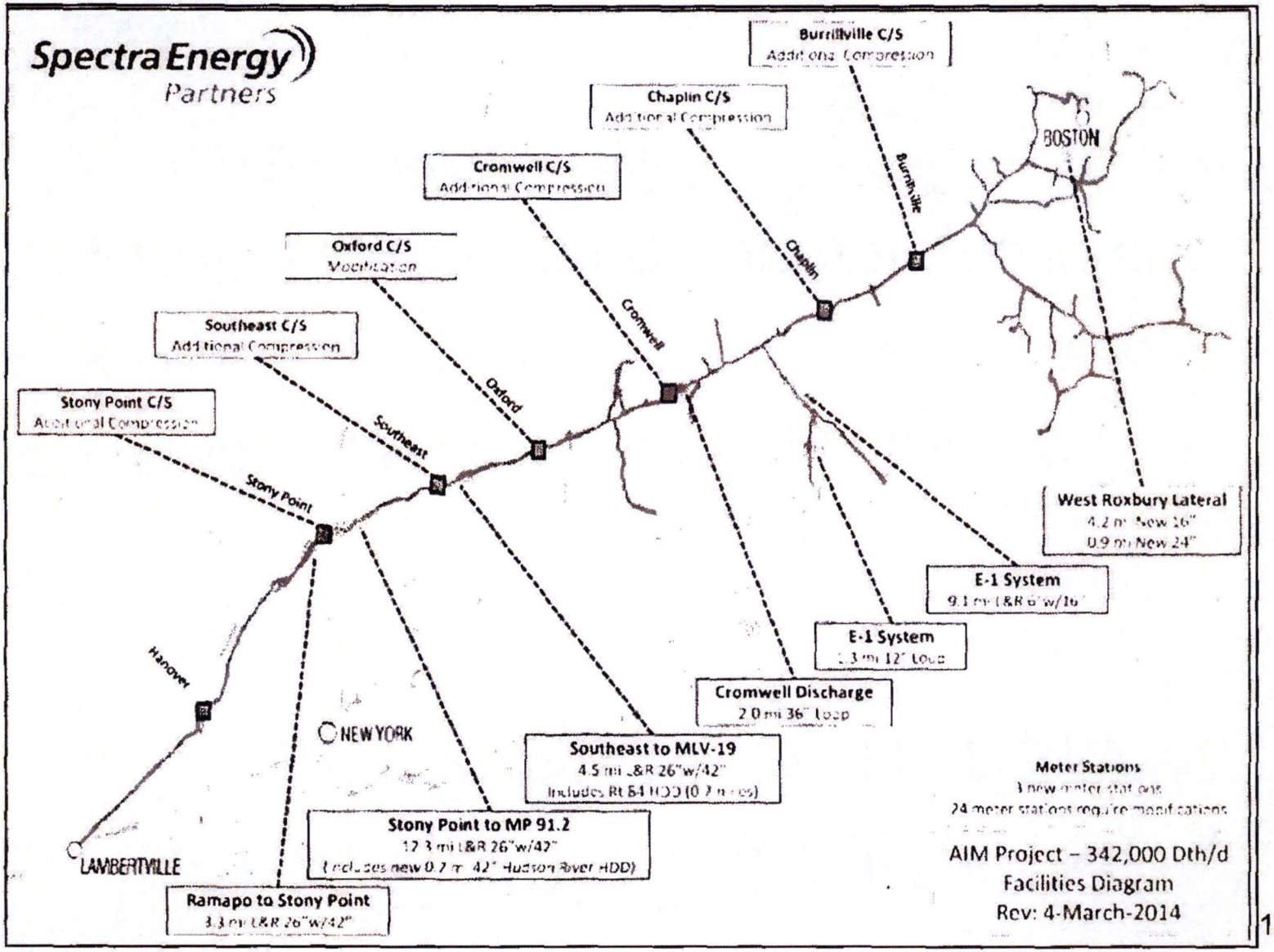
NRC Regulations on liquid radioactive releases

- Nuclear power plant liquid and gaseous releases to the environment are required to be planned, monitored and documented
- NRC regulations (10 CFR Part 20 and 10 CFR Part 50) place limits on these releases to ensure safety standards are being met, such as NRC ALARA limits and EPA drinking-water standards
- On an annual basis, NRC guidelines require that the release of radioactive liquids from a nuclear power plant not result in a radiation dose of greater than 3 millirems to any individual in an unrestricted area

Indian Point Groundwater Contamination Summary

- No health and safety significance
- Promptly detected and investigated
- Building drains and pumping system improvements are underway

Installation of Pipeline



Thresholds for Damage

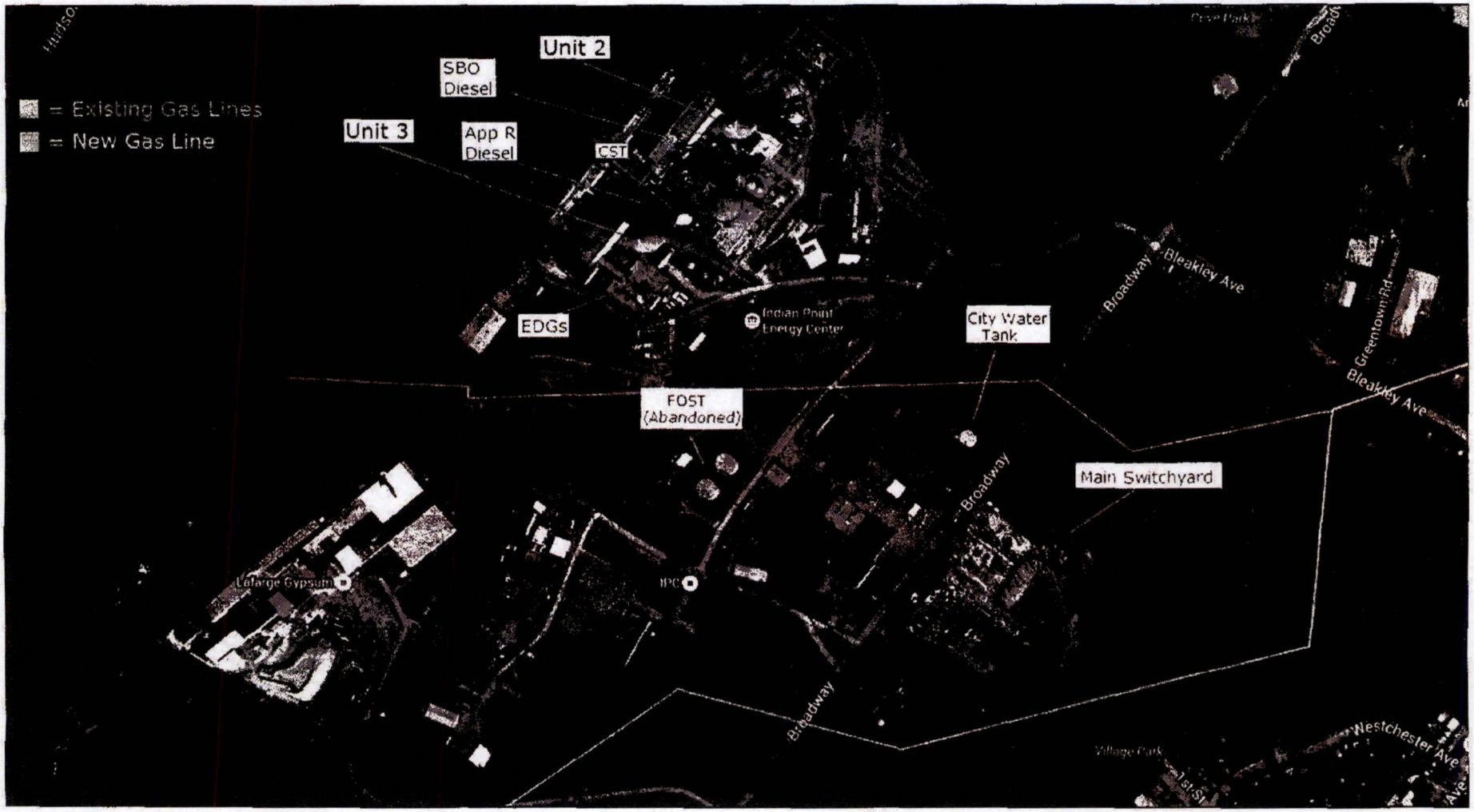
Overpressure	Consequence
1 psi	Glass shatters
2-6 psi	Serious structural damage to houses
6-9 psi	Severe damage to reinforced concrete structures
10 psi	Destruction of Buildings

- **No safety-related structure necessary to safely shutdown IPEC exposed to >1 psi**

Thermal Heat Flux (KW/m2)	Consequence
2	Pain within 60 sec
5	Tolerable to escaping personnel
12.6	Plastic melts
31.5	Building Damage

- **Max heat flux at SOCA boundary found to be about ½ of that which melts plastic**

Installation of Pipeline (Cont'd.)



Installation of Pipeline (Cont'd.)

Summary of Pipeline Installation

- Independent and diverse analysis (NRC, Entergy, DOT) demonstrate no safety impacts.
- Actual explosions confirmed NRC analysis is conservative.
- Plant equipment needed to shutdown would remain available during a pipeline explosion.

Additional information/questions

- Contact Neil Sheehan, NRC Public Affairs Officer, at 610-337-5331 or via e-mail at Neil.Sheehan@NRC.GOV

Elkhiamy, Sarah

From:	Pinson, Brandon
Sent:	Monday, October 19, 2015 8:46 AM
To:	Pickett, Douglas
Subject:	**Sensitive Allegations Material** R1-2015-A-0074 RFI response
Attachments:	RFI response RI-2015-A-0074.pdf

Doug,

See attached for the RFI response regarding the IP3 gas pipelines.

Brandon Pinson
RI, DRP, Branch 2
(610)-337-5390

Elkhiamy, Sarah

From:	Pickett, Douglas V
Sent:	Thursday, December 03, 2015 2:10 PM
To:	DENTEL, GLENN T; Draxton, Mark S; Pinson, Brandon B; Schussler, Jason E
Cc:	HAAGENSEN, BRIAN C; NEWMAN, GARRETT A; RICH, SARAH C
Subject:	Indian Point Gas Pipeline Allegation Support
Attachments:	Indian Pt-Rao's Allegation_analysis_writeup (w corrections 12-1-15).doc

Folks –

Attached is the writeup prepared by Rao in support of the Indian Point existing gas pipeline allegation. It was reviewed by both Mike McCoppin and Zachary Hollcraft. Please let me know whether this will be sufficient for your response. FYI – Rao will be (b)(6) for 5 weeks starting Tuesday, December 8.

Doug

Confirmatory Analysis of Allegation Concern Evaluation
Of
Existing Pipelines Rupture Impact
At Indian Point Energy Center (IPEC)

INTRODUCTION

The licensee, Entergy, provided a response to NRC Request for Information (RI-2015-A-0074). As a part of the staff's review and evaluation of the response and associated attachment and enclosure, the NRC staff performed independent confirmatory calculations to ascertain the reasonability of approach, assumptions and methodology that Entergy used in their evaluation of consequences for the consideration of resolving the concerns raised in this RI. The staff's confirmatory calculations include the determination of the distance to 1 psi overpressure due to potential release of natural gas and explosion at the source of release, due to vapor cloud explosion, and distance to potential heat flux of 12.6 kw/m^2 due to release of gas as a jet fire.

SUMMARY OF EVALUATION

Entergy evaluated the potential hazards to safety-related structures, systems, and components (SSCs) and also SSCs important to safety (SSC ITS) using the BREEZE computer model with reasonable approach and assumptions. The staff performed independent confirmatory calculations with conservative assumptions and rationale using RG 1.91 methodology for source explosion and also used the ALOHA computer model for vapor plume explosion. The staff used the ALOHA model to perform the confirmatory calculations to determine:

1) Distance to 1 psi overpressure due to release and potential at source (at pipe rupture),
2) Distance to 1 psi overpressure due to delayed vapor cloud explosion,
3) Distance to heat flux of 12.6 kw/m^2 from natural gas release as jet fire.

The staff's independent confirmatory calculation results are based on highly conservative assumption and rationale by modeling an instantaneous maximum one minute gas release rate for the potential explosion at the source. The rupture of the pipeline is assumed to be located at the closest SSC. Based on this, the staff concludes that 1 psi overpressure is extended to a distance of (b)(7)(F) which could potentially impact the safety-related SSCs and also the SSCs important to safety. Since the pipeline is buried underground, a more reasonable average release rate, as calculated using ALOHA to determine total amount of gas released over the time period to empty the pipeline, results in a recalculated distance to 1 psi overpressure of (b)(7)(F) In general, the review criterion of 1 psi overpressure provides a margin to failure of safety related SSCs. The safety-related SSCs are designed to withstand overpressure of 3 psi or more without loss of their safety functions. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

The staff's analysis of the distance to overpressure of 1 psi due to a delayed vapor cloud

explosion assumed congestion in the area of release. The results extend the 1 psi overpressure to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (to any SSCs). A sensitivity analysis, which, more realistically, assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

Using the ALOHA model, the staff calculated that the thermal radiation level of 12.6 kW/m^2 would extend to a distance of (b)(7)(F)

Based on the results of the confirmatory analysis, the staff concludes that the safety related SSCs, as well as SSCs important to safety, would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusions.

TECHNICAL EVALUATION

The staff performed an independent confirmatory analysis based on the rupture of the existing 30-inch natural gas pipeline, which consists of about 6 miles of pipeline between isolation valves. The analysis assumed that a rupture of the natural gas pipeline may result in an unconfined explosion or jet flame at the source or in a delayed vapor cloud explosion downwind. For the assessment of an unconfined explosion, the staff used RG 1.91 methodology to calculate the minimum safe distance due to the source explosion. For the jet flame and delayed vapor cloud explosion, the staff used the ALOHA chemical release modeling computer code to determine the hazard impact distances to compare with the actual distances to SSCs related to safety or SSC ITS, in order to assess the impact potential. The ALOHA code is used to calculate the amount of methane released for the scenario considered, using conservative meteorological conditions consisting of an assumed wind speed of 1 m/s, F stability, and 25 deg. C ambient temperature, cloud cover of 0.5 and relative humidity of 50%. Open country ground roughness conditions modeling assumptions were chosen as being appropriate for the location.

Explosion

The ALOHA code model for an explosion scenario conservatively estimated the gas release from a pipe rupture at the closest location to an SSC by considering the length of pipeline to be 6 miles, with the rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. The calculation results give a maximum sustained methane release rate and estimated total release amount over time (to calculate average release rate), based on the closure of the isolation valves following the rupture, assuming that the entire volume of gas in the pipeline section between the closed valves is being released.

Conservatively assuming the maximum one minute release rate, and determining the TNT equivalent amount with a yield factor of 0.05 (WTNT) (equation given below), the minimum

safe distance (d) to 1 psi overpressure is calculated by using RG 1.91 methodology as follows:

WTNT= (Mf * DHC * Y)/4500

where

WTNT= TNT equivalent Mass, kg
Mf = Mass of vapor, kg
DHC = Heat of combustion, kj/kg (50030)
Y = Yield Factor (0.05)
and
$d = 45 * (w)^{1/3}$
where
d= minimum safe distance (ft.) to 1 psi overpressure
w= TNT equivalent mass in pounds

The staff calculated that the safety related SSCs, as well as the SSCs important to safety, located beyond a minimum safe distance of (b)(7)(F) will not be exposed to an overpressure of 1 psi. As the pipeline is buried underground, the use of maximum instantaneous one minute gas release rate may be overly conservative. Therefore, an average rate of gas release based on total amount of gas released over the time period to empty the pipeline, as calculated using ALOHA is assumed as a reasonable value. Using this average gas release rate, the distance to 1 psi overpressure was re-calculated to be (b)(7)(F) Generally the safety-related SSCs are designed to withstand overpressure of 3 psi or more. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

The staff's analysis of the distance to not exceed an overpressure of 1 psi due to delayed vapor cloud explosion assumed congestion in the area of release, which would represent dense forest or buildings which enhance gas accumulation due to potential confinement. The results extend the 1 psi overpressure distance to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (for any SSCs). These results are comparable to that of the licensee's analysis results. A sensitivity analysis, which more realistically assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

Jet Fire

The ALOHA code for jet fire scenarios was run conservatively for the pipe rupture at a location closest to an SSC by considering the length of the pipeline between isolation valves to be 6 miles, with rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. Methane is assumed to be released from the ruptured pipe as a flammable gas and is assumed to be burning. The ALOHA calculation resulted in a maximum burn rate as well as an estimated total amount burned over time, based

on closure of the isolation valves following the rupture. Based on the assumption that the entire volume of gas in the pipeline section between the closed valves is being released, the distances to thermal radiation levels of 31.5 kW/m^2 , 12.6 kW/m^2, and 5.0 kW/m^2 calculated by ALOHA are (b)(7)(F) respectively. A few safety related SSCs and SSCs important to safety may be impacted. These results are consistent with the licensee's analysis results.

CONCLUSION

Based on the results of the staff's independent confirmatory analysis, the staff concludes that the safety-related SSCs as well as SSCs important to safety would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusion. Although the licensee's pipeline hazard impact evaluation used different models, assumptions, and methodology than the staff used in its independent confirmatory analyses, the staff's results and conclusions are consistent with the licensee's results and conclusions. Therefore, the staff considers the licensee's hazard impact evaluation to be reasonable and acceptable.

Tammara, Seshagiri

From:	Tammara, Seshagiri
Sent:	Thursday, December 03, 2015 3:22 PM
To:	McCoppin, Michael
Subject:	RE: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Attachments:	Indian Pt-Rao's Allegation_analysis_writeup (w corrections 12-1-15) (00000002).docx

Mike:

I have addressed the comments and attached herewith the write-up for your review and for further transmittal.

Thanks,
Rao

From: McCoppin, Michael
Sent: Tuesday, December 01, 2015 2:55 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Importance: High

Rao...my edits are included.

Thanks,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

DSEA
DIVISION OF SITE SAFETY AND ENVIRONMENTAL ANALYSIS

Office of New Reactors
United States Nuclear Regulatory Commission

Mail Stop: T7-F03
Office: T7-F18
Ph: 301.415.6533
Cell: (b)(6)
FAX: 301.415.5399
Email: michael.mccoppin@nrc.gov

have received this communication in error, please notify me immediately by return e-mail and delete the original message and any copies of it from your computer system.

Confirmatory Analysis of Allegation Concern Evaluation
Of
Existing Pipelines Rupture Impact
At Indian Point Energy Center (IPEC)

INTRODUCTION

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where

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DHC = Heat of combustion, kj/kg (50030)
Y = Yield Factor (0.05)
and
$d = 45 * (w)^{1/3}$
where
d= minimum safe distance (ft.) to 1 psi overpressure
w= TNT equivalent mass in pounds

As the pipeline is buried underground, an average rate of gas release based on total amount of gas released over the time period to empty the pipeline, as calculated using ALOHA is assumed. Using this average gas release rate, the distance to 1 psi overpressure was calculated to be (b)(7)(F) Generally the safety-related SSCs are designed to withstand overpressure of 3 psi or more. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

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Jet Fire

The ALOHA code for jet fire scenarios was run conservatively for the pipe rupture at a location closest to an SSC by considering the length of the pipeline between isolation valves to be 6 miles, with rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. Methane is assumed to be released from the ruptured pipe as a flammable gas and is assumed to be burning. The ALOHA calculation resulted in a maximum burn rate as well as an estimated total amount burned over time, based on closure of the isolation valves following the rupture. Based on the assumption that the entire volume of gas in the pipeline section between the closed valves is being released, the distances to thermal radiation levels of 31.5 kW/m^2, 12.6 kW/m^2, and 5.0 kW/m^2 calculated by ALOHA are (b)(7)(F) respectively. A few safety related SSCs and SSCs important to safety may be impacted. These results are consistent with the licensee's analysis results.

CONCLUSION

Based on the results of the staff's independent confirmatory analysis, the staff concludes that the safety-related SSCs as well as SSCs important to safety would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusion. Although the licensee's pipeline hazard impact evaluation used different models, assumptions, and methodology than the staff used in its independent confirmatory analyses, the staff's results and conclusions are consistent with the licensee's results and conclusions. Therefore, the staff considers the licensee's hazard impact evaluation to be reasonable and acceptable.

Tammara, Seshagiri

From:	Tammara, Seshagiri
Sent:	Friday, December 04, 2015 9:27 AM
To:	McCoppin, Michael; Pickett, Douglas; Dentel, Glenn
Cc:	Hollcraft, Zachary
Subject:	FW: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Attachments:	Indian Pt-Rao's Allegation_analysis_writeup (w corrections 12-3-15) (00000002).docx; IPEC_exisiting_pipelines_impact_writeup_redac.pdf

Mike/Doug/Glen:

I am on (b)(6) Mike attached and transmitted the above file yesterday. In case there is a FOIA request, I have identified in yellow/red the potential results that may be redacted, and attached that scanned file (.pdf) for your convenience and easy referral.

Thanks,
Rao

From: McCoppin, Michael
Sent: Thursday, December 03, 2015 3:54 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: RE: existing pipeline hazard evaluation write-up for IPEC allegation

Folks,

Some minor edits as discussed between Glenn, Rao, and I today. Please feel free to make any editorial edits as you see fit.

Regards,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

DSEA
DIVISION OF SITE SAFETY AND ENVIRONMENTAL ANALYSIS

Office of New Reactors
United States Nuclear Regulatory Commission

Mail Stop: T7-F03
Office: T7-F18
Ph: 301.415.6533
Cell: (b)(6)
FAX: 301.415.5399
Email: michael.mccoppin@nrc.gov

From: McCoppin, Michael
Sent: Tuesday, December 01, 2015 2:55 PM
To: Tammara, Seshagiri <Seshagiri.Tammara@nrc.gov>; Dentel, Glenn <Glenn.Dentel@nrc.gov>; Pickett, Douglas <Douglas.Pickett@nrc.gov>
Cc: Hollcraft, Zachary <Zachary.Hollcraft@nrc.gov>
Subject: RE: existing pipeline hazard evaluation write-up for IPEC allegation
Importance: High

Rao...my edits are included.

Thanks,

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)

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Confirmatory Analysis of Allegation Concern Evaluation
Of
Existing Pipelines Rupture Impact
At Indian Point Energy Center (IPEC)

INTRODUCTION

The licensee, Entergy, provided a response to NRC Request for Information (RI-2015-A-0074). As a part of the staff's review and evaluation of the response and associated attachment and enclosure, the NRC staff performed independent confirmatory calculations to ascertain the reasonability of approach, assumptions and methodology that Entergy used in their evaluation of consequences for the consideration of resolving the concerns raised in this RI. The staff's confirmatory calculations include the determination of the distance to 1 psi overpressure due to potential release of natural gas and explosion at the source of release, due to vapor cloud explosion, and distance to potential heat flux of 12.6 kw/m^2 due to release of gas as a jet fire.,

SUMMARY OF EVALUATION

Entergy evaluated the potential hazards to safety-related structures, systems, and components (SSCs) and also SSCs important to safety (SSC ITS) using the BREEZE computer model with reasonable approach and assumptions. The staff performed independent confirmatory calculations with conservative assumptions and rationale using RG 1.91 methodology for source explosion and also used the ALOHA computer model for vapor plume explosion. The staff used the ALOHA model to perform the confirmatory calculations to determine:

1) Distance to 1 psi overpressure due to release and potential at source (at pipe rupture),
2) Distance to 1 psi overpressure due to delayed vapor cloud explosion,
3) Distance to heat flux of 12.6 kw/m^2 from natural gas release as jet fire.

The staff's independent confirmatory calculation results are based on highly conservative assumption and rationale by modeling the gas release rate for the potential explosion at the source. The rupture of the pipeline is assumed to be located at the closest SSC. Since the pipeline is buried underground, an average release rate, as calculated using ALOHA to determine total amount of gas released over the time period to empty the pipeline, results in a calculated distance to 1 psi overpressure of (b)(7)(F) In general, the review criterion of 1 psi overpressure provides a margin to failure of safety related SSCs. The safety-related SSCs are designed to withstand overpressure of 3 psi or more without loss of their safety functions. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

The staff's analysis of the distance to overpressure of 1 psi due to a delayed vapor cloud explosion assumed congestion in the area of release. The results extend the 1 psi overpressure to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (to any SSCs). A sensitivity analysis, which,

more realistically, assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

Using the ALOHA model, the staff calculated that the thermal radiation level of 12.6 kW/m^2 would extend to a distance of (b)(7)(F)

Based on the results of the confirmatory analysis, the staff concludes that the safety related SSCs, as well as SSCs important to safety, would potentially be exposed to 1 psi overpressure, and a few SSCs important to safety may be exposed to heat flux of 12.6 kw/m^2, which is comparable to the licensee's conclusions.

TECHNICAL EVALUATION

The staff performed an independent confirmatory analysis based on the rupture of the existing 30-inch natural gas pipeline, which consists of about 6 miles of pipeline between isolation valves. The analysis assumed that a rupture of the natural gas pipeline may result in an unconfined explosion or jet flame at the source or in a delayed vapor cloud explosion downwind. For the assessment of an unconfined explosion, the staff used RG 1.91 methodology to calculate the minimum safe distance due to the source explosion. For the jet flame and delayed vapor cloud explosion, the staff used the ALOHA chemical release modeling computer code to determine the hazard impact distances to compare with the actual distances to SSCs related to safety or SSC ITS, in order to assess the impact potential. The ALOHA code is used to calculate the amount of methane released for the scenario considered, using conservative meteorological conditions consisting of an assumed wind speed of 1 m/s in the direction of the SSC, F stability, 25 deg. C ambient temperature, cloud cover of 0.5 and relative humidity of 50%. Open country ground roughness conditions modeling assumptions were chosen as being appropriate for the location.

Explosion

The ALOHA code model for an explosion scenario conservatively estimated the gas release from a pipe rupture at the closest location to an SSC by considering the length of pipeline to be 6 miles, with the rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. The calculation results give an estimated total methane release amount over time (to calculate the average release rate) based on the closure of the isolation valves following the rupture, assuming that the entire volume of gas in the pipeline section between the closed valves is being released.

Assuming the average release rate, and determining the TNT equivalent amount with a yield factor of 0.05 (WTNT) (equation given below), the minimum safe distance (d) to 1 psi overpressure is calculated by using RG 1.91 methodology as follows:

WTNT= (Mf * DHC * Y)/4500

where

WTNT= TNT equivalent Mass, kg
Mf = Mass of vapor, kg
DHC = Heat of combustion, kj/kg (50030)
Y = Yield Factor (0.05)
and
$d= 45 * (w)^{1/3}$
where
d= minimum safe distance (ft.) to 1 psi overpressure
w= TNT equivalent mass in pounds

As the pipeline is buried underground, an average rate of gas release based on total amount of gas released over the time period to empty the pipeline, as calculated using ALOHA is assumed. Using this average gas release rate, the distance to 1 psi overpressure was calculated to be (b)(7)(F) Generally the safety-related SSCs are designed to withstand overpressure of 3 psi or more. In order to estimate the distance to potential 3 psi overpressure, using the same average release rate, the distance to 3 psi overpressure is calculated to be (b)(7)(F)

The staff's analysis of the distance to not exceed an overpressure of 1 psi due to delayed vapor cloud explosion assumed congestion in the area of release, which would represent dense forest or buildings which enhance gas accumulation due to potential confinement. The results extend the 1 psi overpressure distance to impact some safety-related SSCs and SSCs important to safety. However, the overpressure did not exceed 3 psi at any distance (for any SSCs). These results are comparable to that of the licensee's analysis results. A sensitivity analysis, which more realistically assumed no congestion in the area, resulted in no 1 psi overpressure at any distance due to vapor cloud explosion.

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The ALOHA code for jet fire scenarios was run conservatively for the pipe rupture at a location closest to an SSC by considering the length of the pipeline between isolation valves to be 6 miles, with rupture creating a hole equivalent to the diameter of the pipe (30 inches diameter) at a maximum operating pressure of 674 psia. Methane is assumed to be released from the ruptured pipe as a flammable gas and is assumed to be burning. The ALOHA calculation resulted in a maximum burn rate as well as an estimated total amount burned over time, based on closure of the isolation valves following the rupture. Based on the assumption that the entire volume of gas in the pipeline section between the closed valves is being released, the distances to thermal radiation levels of 31.5 kW/m^2, 12.6 kW/m^2, and 5.0 kW/m^2 calculated by ALOHA are (b)(7)(F) respectively. A few safety related SSCs and SSCs important to safety may be impacted. These results are consistent with the licensee's analysis results.

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