UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 21, 2000

LICENSEE: Entergy Operations, Inc.

FACILITY: Grand Gulf Nuclear Station, Unit 1

SUBJECT: SUMMARY OF FEBRUARY 16, 2000, MEETING TO DISCUSS IMPLEMENTATION OF THE ALTERNATE SOURCE TERM AT GRAND GULF NUCLEAR STATION, UNIT 1 (TAC NO. MA8065)

A public meeting was held at the Nuclear Regulatory Commission (NRC) headquarters in Rockville, Maryland on Wednesday, February 16, 2000, between the NRC staff and Entergy Operations, Inc. (EOI, or the licensee), the licensee for Grand Gulf Nuclear Station (GGNS). The meeting was held at the request of the licensee to discuss the EOI submittal of a licensing change request for full scope implementation at GGNS of the alternate source term as described in NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," published February 1995. Enclosure 1 is a list of meeting attendees and Enclosure 2 is the presentation material provided by the licensee.

NUREG-1465 documents the past 30 years of severe accident research into fission product releases for light-water nuclear power plants, such as GGNS. The NUREG provides what is considered by the Commission as more realistic estimates of the radionuclide releases into containment during postulated design basis accidents in terms of timing, nuclide types, quantities, and chemical form. GGNS was licensed using the nonmechanistic TID-14844 source term that is the basis of Regulatory Guides 1.3 and 1.4. However, the revised source terms of NUREG-1465 may be voluntarily applied to light-water nuclear power plants such as GGNS.

EOI presented this submittal as a full scope implementation of the alternate source term (AST). Other related GGNS licensing change initiatives include the limited scope reviews for relaxed secondary containment and control room requirements during refueling outages (granted in GGNS Amendment No. 139) and the change in design basis for the timing of gap activity release currently under staff review. The full scope AST submittal includes changes to the Technical Specifications revised in GGNS Amendment No. 139 due to implementation of the NUREG-1465 source terms. The design basis change request for revision of the timing of gap activity release is not affected by this full scope AST submittal.

EOI outlined its general AST implementation philosophy and the overall scope of the AST submittal for GGNS. Detailed presentations followed which concentrated on three specific topics:

- Equipment Qualification
- Control Room Habitability
- Suppression Pool Chemistry and Iodine Re-evolution

Equipment qualification studies by GGNS have concluded that all equipment has sufficient margin to accommodate AST implementation, including the potential effects of increased cesium in the suppression pool water. Recognizing that increased cesium in containment water

is potentially a generic safety issue for all operating reactors, GGNS identified and evaluated all equipment in close proximity to, or otherwise exposed to the suppression pool water for any adverse impact on equipment qualification margins.

Several control room-related changes were presented, including an increase in the GGNS design basis allowable control room unfiltered air inleakage to 1200 cubic feet per minute (cfm). This discussion prompted questions regarding the analytical qualification for this new design basis. These questions will be assembled in a formal request for additional information (RAI) from the staff. GGNS is a member of the joint NRC/Nuclear Energy Institute Task Force on the control room habitability issue, and is committed to adoption of the forthcoming task force guidance for demonstration of design basis compliance on this issue. The staff agreed to proceed with review of the GGNS license amendment request for acceptance of 1200 cfm inleakage into the control room, and indicated that this review may be completed prior to the resolution of the generic issues associated with control room habitability. The staff further stated that the review and future approval of this amendment request would not exempt GGNS from regulatory actions that may be implemented in the future as this generic issue is resolved.

A detailed technical presentation was provided addressing suppression pool water pH methodology and analytical results based on GGNS calculations, included as attachments to the AST submittal. There were no specific questions raised on this issue during the presentation. Due to the level of technical detail included in these calculations, additional staff review effort is required for complete evaluation.

EOI was commended by the staff for providing a comprehensive and well organized submittal. There appear to be no significant problems in the proposed changes, and no exceptions identified to draft regulatory guidance (DG-1081) on this issue. A formal RAI will be generated by the staff to capture the various technical questions discussed during the presentation.

The schedule projected for review of the GGNS submittal includes a comprehensive safety evaluation by the NRC staff by the end of October 2000. The lead staff organization for the technical review is the Probabilistic Safety Assessment Branch, with assistance from the Materials & Chemical Engineering Branch, the Mechanical & Civil Engineering Branch, and the Reactor Systems Branch, as necessary.

The licensee completed its presentation at about 1:30 P.M. and the meeting was closed.

/RA/

S. Patrick Sekerak, Project Manager, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosures: 1. List of Meeting Attendees
2. Licensee's Presentation Material

cc w/encl: See next page

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DATED: March 21, 2000

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Meeting with Entergy Operations, Inc.

Wednesday, February 16, 2000

List of Attendees

NAME	ORGANIZATION
J. Burford	EOI
G. Broadbent	EOI/GGNS
M. Withrow	EOI/GGNS
T. Heames	ITSC
C. Cozens	NEI
L. Brown	NRR/SPSB
S. LaVie	NRR/SPSB
J. Lee	NRR/SPSB
F. M. Reinhart	NRR/SPSB
K. Parczewski	NRR/EMCB
S. P. Sekerak	NRR/DLPM

EOI = Entergy Operations, Inc.
ITSC = Innovative Technology Solutions Corp.
NEI = Nuclear Energy Institute
NRR = Office of Nuclear Reactor Regulation
SPSB = Probabilistic Safety Assessment Branch
EMCB = Materials & Chemical Engineering Branch
DLPM = Division of Licensing Project Management

Enclosure 1

Entergy

GGNS Entergy

Enclosure 2

Grand Gulf Nuclear Station
Full Scope Implementation of
Alternative Source Terms

January 25, 2000

Alternative Source Terms

GGNS
Entergy

- Agenda
  - Introduction
    - » participants
    - » submittal
  - Equipment Qualification
  - Control Room Habitability
  - Suppression Pool Chemistry and Iodine Re-evolution
  - Questions and Answers

Alternative Source Terms

GGNS
Entergy

- Equipment Qualification
  - SECY 98-154
    - » concluded increased Cs in containment water could impact EQ
    - » potential GSI for all operating reactors
  - Rebaselining Study demonstrated
    - » TID-14844 airborne source term always bounding
    - » AST waterborne source term exceeds TID at ~146 days for BWRs
  - GGNS UFSAR EQ coping duration is 180 days

Alternative Source Terms

GGNS
Entergy

- Equipment Qualification Evaluation
  - EQ profiles not affected by AST applications - only affected by increased cesium in the containment water
  - At 180 days post-accident, AST integrated dose is 12.5% higher than TID-based dose to equipment exposed to sup. pool water
  - All potentially affected equipment identified and evaluated
    - » EQ equipment in close proximity to pool surface
    - » ESF equipment in aux. bldg. exposed to pool water
  - Study concluded all equipment has sufficient margin for AST (including the 10% additional margin required by R.G. 1.89)

Alternative Source Terms

GGNS
Entergy

- Control Room-related changes
  - increase allowable control room inleakage
  - remove CRFA auto-initiate instruments from technical specifications
  - remove CRFA fans and filtration equipment from technical specifications
  - revise technical specification applicability for control room - not needed during core alterations or during handling of recently irradiated fuel

Alternative Source Terms

GGNS
Entergy

- Control Room Habitability Issue
  - Concern that plants are not meeting their design / licensing bases
  - Joint NRC / NEI task Force effort to develop guidance
- Demonstrate Bases are satisfied
  - understand the bases
  - compare bases with design analyses, configuration, and operation
  - assess vulnerability to selected generic issues
  - evaluate and address any discrepancies
  - establish envelope maintenance program features

Alternative Source Terms

GGNS
Entergy

- Conclusions and Schedule
  - EOI is actively participating in the NRC / NEI effort
  - NEI 99-03 Guidance scheduled for EOY '00

  - Submittal proposes revisions to licensing bases
  - Supporting accident analyses involved a recent review of system features and design
  - Requesting NRC review of submittal by October '00

- Submittal represents a change to Bases
  - establishes baseline for the demonstration that bases are met

GGNS POOL pH TECHNICAL DOCUMENTS

GGNS
Entergy

- Engineering Report GGNS-98-0039, Rev. 1
  - Documents the GGNS pool pH methodology
- Calculation XC-Q1111-98013, Rev. 0
  - Documents the GGNS Pool pH Analysis
- Calculation XC-Q1111-98014, Rev. 1
  - Documents some sensitivity calculations performed on the GGNS pool pH results
  - Considers the impact of iodine re-evolution

pH METHODOLOGY

GGNS
Entergy

- Methodology derived from NUREG/CR-5950
- Considered:
  - HI
    - » from released iodine
    - » not significant source of acid
  - HNO_3
    - » generated in suppression pool water
  - HCl
    - » radiolysis of chloride-bearing cable insulation
    - » pyrolysis not considered
  - CsOH
    - » from released cesium that is not in the CsI species

pH METHODOLOGY

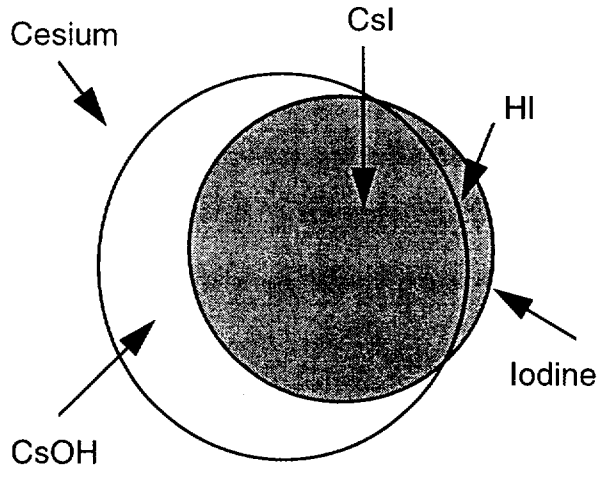
GGNS
Entergy

- Assumptions
  - 30 day evaluation period
    - » determine iodine re-evolution contribution to doses
  - Timed Releases
    - » consistent with NUREG-1465
  - EQ airborne and pool doses
    - » TID doses bounding for BWRs based on re-baselining results

pH METHODOLOGY

GGNS
Entergy

- Calculation of HI and CsOH
  - Core inventory calcs for core I and Cs inventories
    - » including stable isotopes (ORIGEN)
  - Assumed 95% of iodine is in the form of CsI
  - Remaining iodine in the form of HI
  - Remaining cesium in the form of CsOH



pH METHODOLOGY

GGNS
Entergy

- Nitric Acid
  - Proportional to pool dose
  - Generation constant from NUREG/CR-5950
  - Pool doses based on TID are acceptable
    - » since BWR integrated dose profiles are bounded for >30 days

$$\frac{d}{dt}[HNO_3] = 7.3E-6 \frac{mol\ HNO_3}{L-Megarad} * \dot{X}(t)_{pool}$$

$$[HNO_3](t) = 7.3E-6 \int_0^t \dot{X}(t)_{pool}\, dt$$

pH METHODOLOGY

GGNS
Entergy

- HCl Generation Assumptions
  - No generation from cable in conduits or totally enclosed raceways
    - » sealed raceways, water-resistant fittings
    - » routed by spec for electrical independence
    - » no significant driving force for containment atmosphere entering conduit
    - » shielded from beta radiation, not gamma
    - » potential for limited HCl production from gamma radiation
      - gamma generation term is small
      - enclosed environment with significant metal surfaces
      - no significant path out of the conduit
  - Beta dose reduction by factor of 2 for cable in trays
    - » per NUREG-0588, Rev. 1 Section 1.4(9)
    - » leads to 2 classes of cable
      - trays and "free air drops"

pH METHODOLOGY

GGNS
Entergy

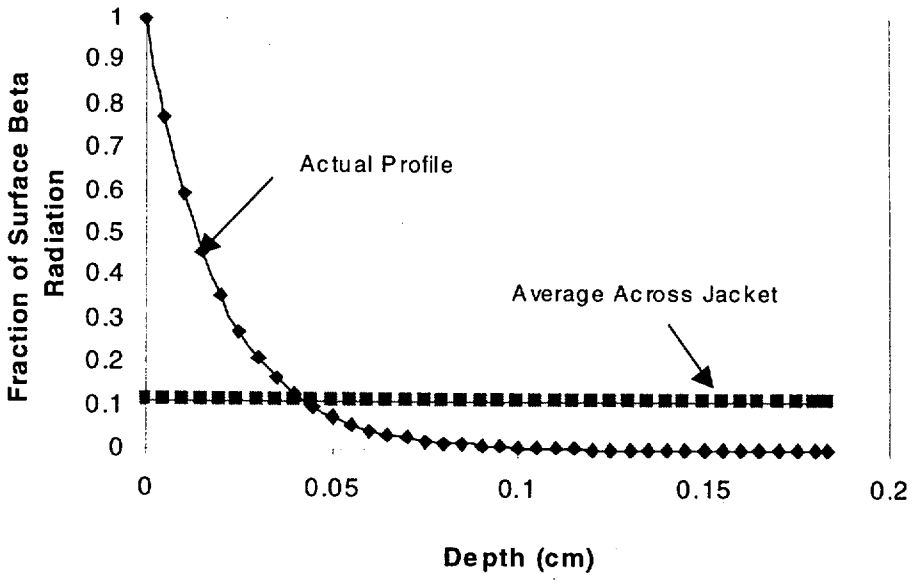
- HCl Generation (cont'd)
  - $R=G*M*\bar{\phi}*A$
  - where:
    - » *R* = HCl production rate
    - » *G* = radiation G value for Hypalon,
      - 2.115 molecules HCl per 100 eV
    - » *M* = Hypalon mass,
    - » $\bar{\phi}$ = average radiation energy flux in the Hypalon jacket
    - » *A* = absorption fraction of energy flux in the Hypalon jacket
      - $1 - e^{-\mu th}$

pH METHODOLOGY

GGNS
Entergy

- HCl Generation (cont'd)
  - Cable Self-Shielding Considered

$$\frac{\bar{\phi}(th)}{\phi(R_o)} = \frac{\frac{1}{\mu^2}\left[e^{-\mu \cdot th}(\mu \cdot th + 1) - 1\right] - \frac{R_o}{\mu}\left(e^{-\mu \cdot th} - 1\right)}{R_o \cdot th - \frac{th^2}{2}}$$

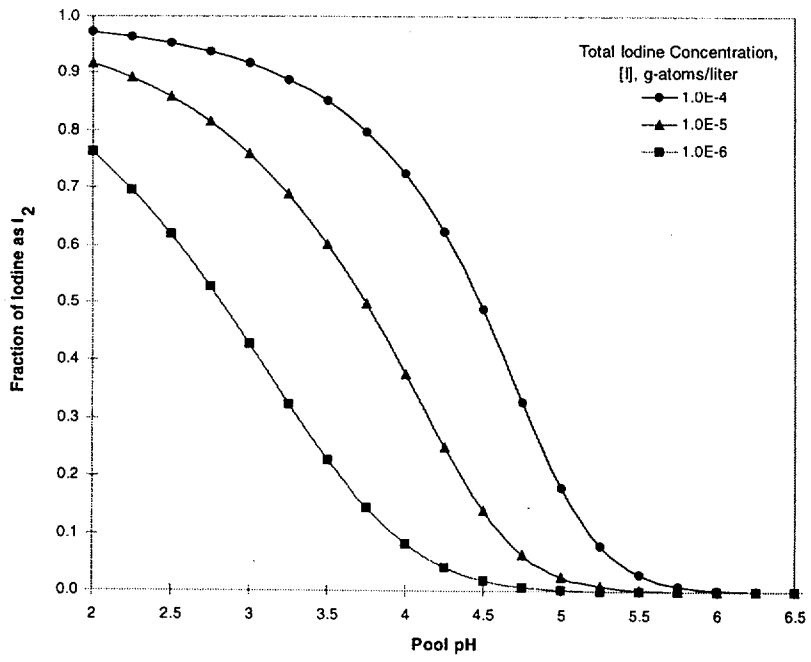


pH METHODOLOGY

GGNS
Entergy

- pH-Driven Iodine Re-evolution
  - Governing Equation:

$$[I_2]_{aq} = \frac{[I]_{aq}}{2} + \frac{d + e10^{-pH}}{8 * 10^{-2pH}} - \frac{1}{8 * 10^{-pH}} \sqrt{\frac{\left(d + e10^{-pH}\right)^2}{10^{-2pH}} + 8[I]_{aq} * \left(d + e10^{-pH}\right)}$$



$$PC = \frac{[I_2]_{aq}}{[I_2]_{gas}} = 10^{6.29 - 0.0149T}$$

GGNS pH CALCULATION

GGNS Entergy

- Inputs
  - Initial pool pH = 5.3
    - » min. allowable under GGNS chemistry procedures
  - Core inventory
    - » ORIGEN 2.1 analysis at EOC conditions
    - » iodine: 325 g-atoms
    - » cesium: 2400 g-atoms
    - » includes stable isotopes
  - Minimum suppression pool inventory
    - » Included additional water inventory from upper pool dump
      - occurs automatically at 30 minutes

GGNS pH CALCULATION

GGNS Entergy

- Exposed Cable Inventory
  - Pounds insulation and jacket (no conductor)

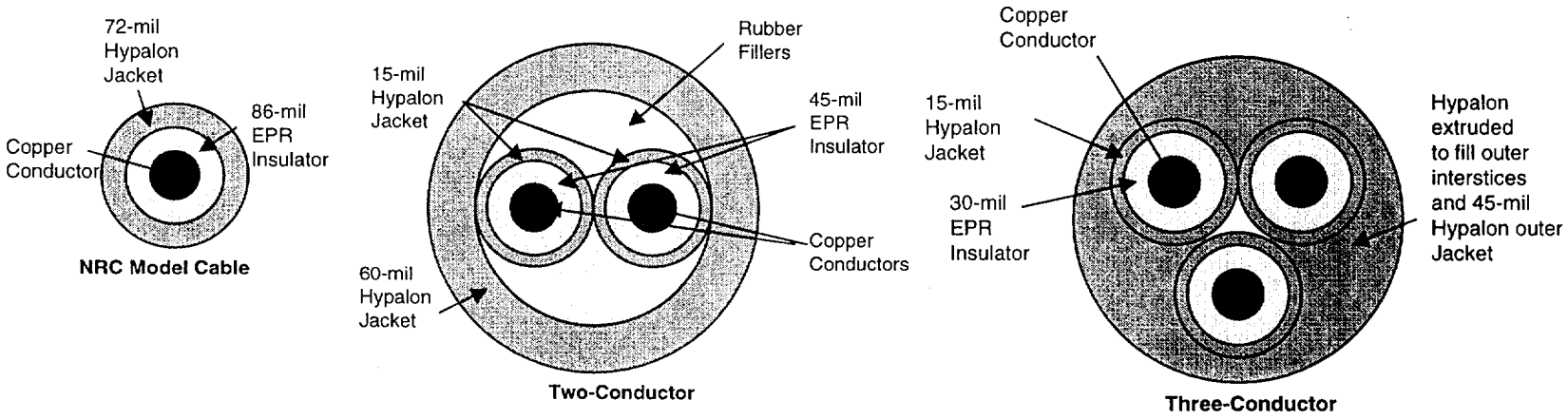
	Trays	Free Air Drop
Drywell	874	874
Containment	14,049	1,561

- Previously reported for rebaselining
  - Drywell: 9,835 pounds
  - Containment: 176,400 pounds

GGNS pH CALCULATION

GGNS Entergy

- GGNS Cable Types



- Limiting Cable Type (on a per-pound basis)
  - two-conductor Okonite cable with a 45-mil jacket
  - larger HCl generator than NRC model cable
  - GGNS calc assumed all cable was this limiting type

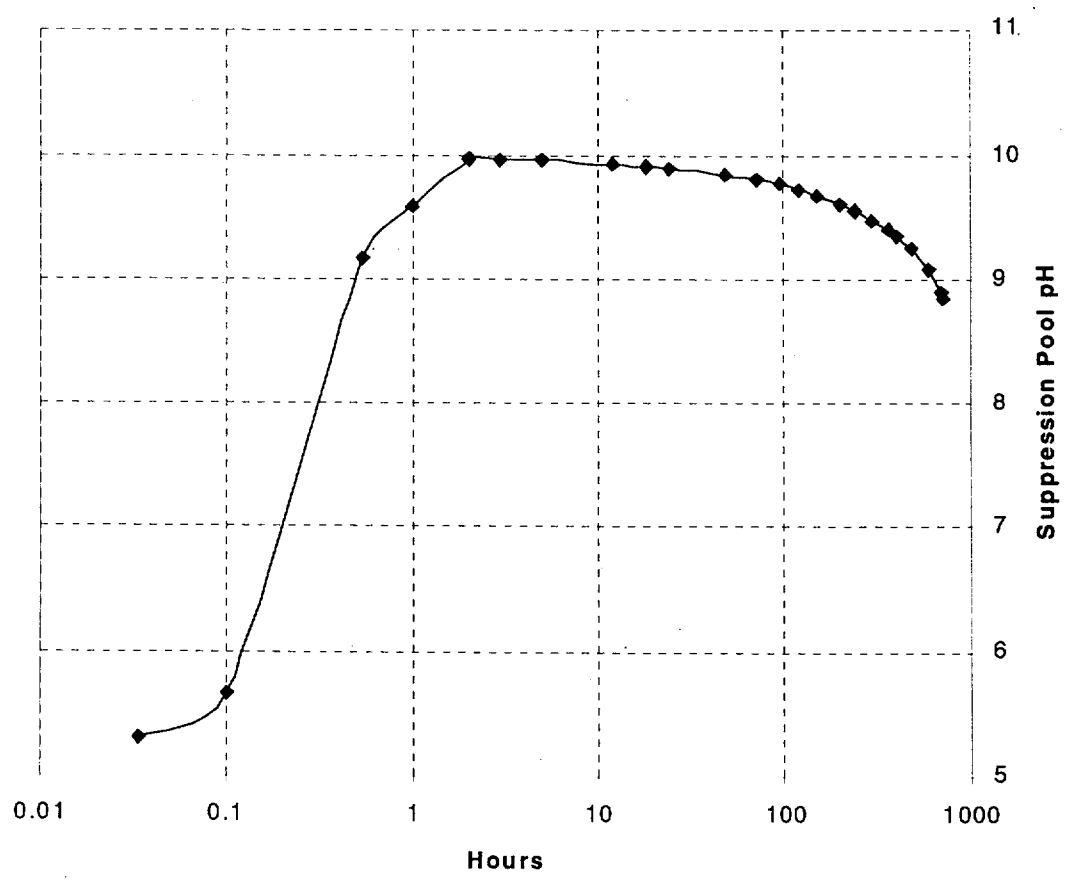
GGNS pH CALCULATION

GGNS Entergy

- Pyrolysis
  - Preliminary Review Results
    - » Elevated temperatures in upper region of the drywell
    - » No elevated temperatures in containment or other drywell regions
    - » GGNS reviewing cable inventories in affected area

GGNS pH CALCULATION

GGNS Entergy



GGNS Post-Accident pH Transient

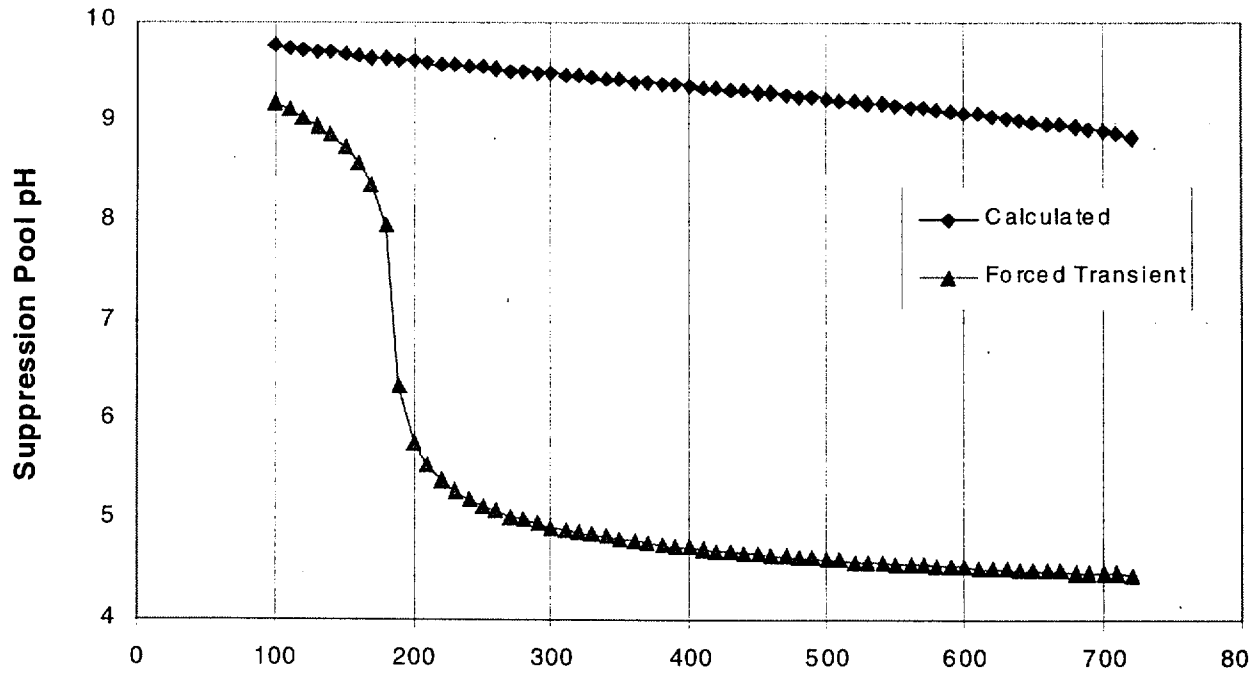
IODINE RE-EVOLUTION

GGNS Entergy

- Investigated Radiological Consequences of a Reduced CsOH release
  - Reduced CsOH to 60% of original value
  - Calculated transient pool pH
    - » Late-term pH transient resulted
  - iodine re-evolution
    - » all released core iodine assumed in pool
    - » assumed iodine conc throughout containment was same as that above pool
  - Calculated offsite and control room TEDE doses
    - » considered proposed relaxations

IODINE RE-EVOLUTION

GGNS
Entergy



Forced Pool pH Transient

IODINE RE-EVOLUTION

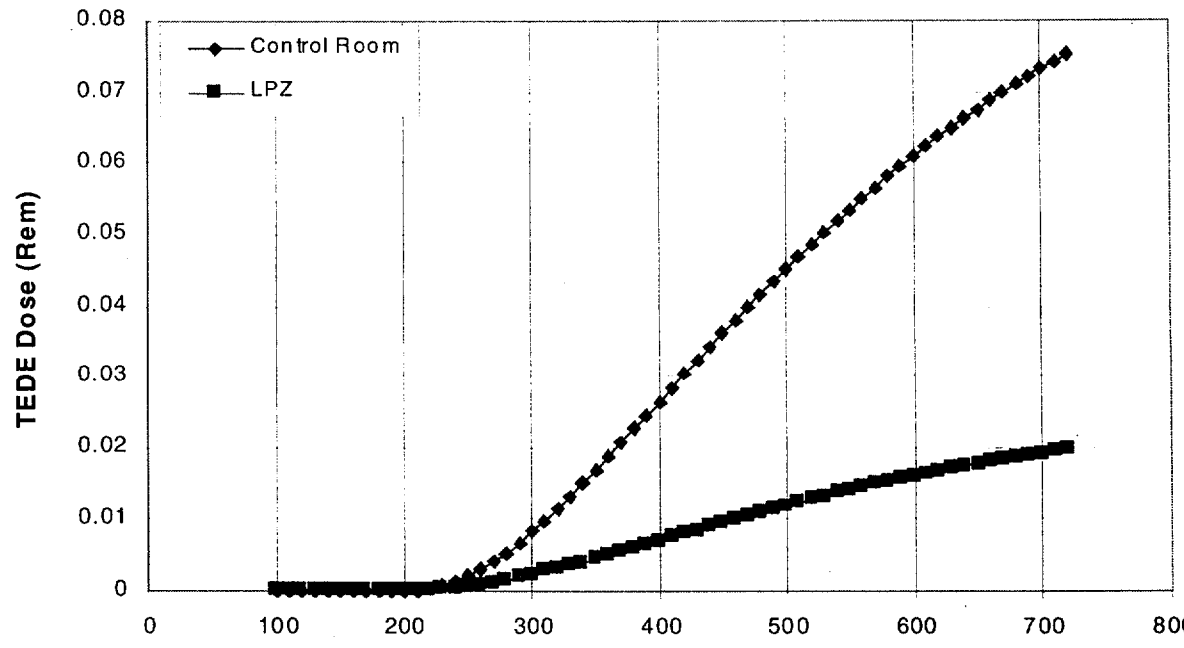
GGNS
Entergy

- Visual C++ program
  - 1 second increments
  - Time-varying pH and suppression pool temperature
  - Applied iodine re-evolution equation

- Benchmarked
  - against an analytic solution

IODINE RE-EVOLUTION

GGNS
Entergy



Resulting Radiological Consequences

IODINE RE-EVOLUTION

GGNS
Entergy

- Conclusions
  - late-term (after 96 hour) pH transient results in insignificant radiological results because:
    - » the EAB has been evacuated and the control room occupancy factor is reduced
    - » the LPZ and control room χ/Q values are reduced
    - » the suppression pool temperature has decreased from its peak (higher partition coefficient)
    - » a significant fraction of the containment iodine inventory has decayed.