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

April 24, 1985

Docket Nos. 50-237/249
LS05-85-04-034

LICENSEE: Commonwealth Edison Company (CECo)

FACILITIES: Dresden Nuclear Power Station, Unit Nos. 2 and 3

SUBJECT: SUMMARY OF MEETING HELD ON MARCH 21, 1985

The NRC staff held a meeting with representatives of CECo, Air Products and Chemical, Inc. and Stearns Catalytic Corporation to discuss issues relating to the placement of a liquid hydrogen storage tank on the Dresden site for use in the hydrogen water chemistry program. A list of attendees is provided in Enclosure 1 and copies of the viewgraphs used by CECo during the meeting are presented in Enclosure 2.

While there was some discussion of the hydrogen water chemistry program and its efficacy during its use at Dresden Unit 2, the main thrust of the discussions involved the present delivery system for the hydrogen (hydrogen tube trailers delivered one per day) and the replacement of this system with a liquid hydrogen tank which needs to be filled less often and which, according to CECo studies based on a 50.59 analysis, would be safe and more cost effective.

It is the staff's position that CECo's 50.59 evaluation is flawed and that a staff review of the factors involved with the tank placement is necessary since the CECo 50.59 analysis is done on a probabilistic basis and the staff uses a deterministic approach to analyze fixed sources of toxic, flammable and explosive materials on a site. Following discussions between the parties, it was agreed that, if the tank failed and explosion or ignition of the hydrogen occurred at the proposed site of the tank, there was no significant hazard to safety related structures. However, if explosion or ignition does occur at the tank site and the hydrogen cloud drifts over the turbine building (TB) and then explodes, the overpressure developed would exceed the structural integrity of the TB and the control room could be rendered inoperable.

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It was agreed that attempts would be made to re-evaluate the hydrogen evaporative conditions to see if deterministic mitigation procedures exist which could reduce the amount of hydrogen volatilized such that the explosive potential of the drifting hydrogen would not exceed the structural integrity of safety-related structures. Additional discussions are planned.

Original Signed by

Robert A. Gilbert, Project Manager
Operating Reactors Branch #5
Division of Licensing

Enclosures:
1. List of Attendees
2. Viewgraph copies

cc w/enclosures:
See next page

DISTRIBUTION
Docket
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DL:ORB#5	DL:ORB#5	DL:ORB#5
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April 24, 1985

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Enclosure 1

ATTENDANCE LIST

DRESDEN NUCLEAR POWER STATION, UNIT NOS. 2 and 3

MEETING OF MARCH 21, 1985

Name	Affiliation
E. Markee	NRC
C. Ferrell	NRC
K. Campe	NRC
B. Rybak	Commonwealth Edison
E. Rowley	Commonwealth Edison
S. West	NRC
F. Witt	NRC
V. Benaroya	NRC
R. Gilbert	NRC
R. Linney	Air Products & Chem., Inc.
L. Doelp	Air Products & Chem., Inc.
W. Paulson	NRC
M. Strait	Commonwealth Edison
P. Reichert	Stearns Catalytic Corp.
T. Seeley	Stearns Catalytic Corp.
D. Helwig	Philadelphia Electric Co.
L. Gifford	General Electric Co.
E. Kearney	Boston Edison Co.
P. Leech	NRC

PURPOSE

The purpose of this meeting is to review the process and conclusions reached in the Safety Evaluation performed by Commonwealth Edison for the Hydrogen Water Chemistry Modifications and attempt to resolve the NRC concerns.

AGENDA

- Hydrogen Water Chemistry Program
- History of HWC at Dresden Unit 2
- Safety Evaluation

HYDROGEN WATER CHEMISTRY PROGRAM

Intergranular Stress Corrosion Cracking (IGSSC) of Recirculation and other piping systems has had a significant impact on BWR plant availability. Numerous remedies including alternate pipe alloys and stress improvement treatment that put the pipe welds in compression have been developed and implemented. More recently, Hydrogen Water Chemistry (HWC) has gotten attention as an alternative means of providing protection against IGSCC.

Three conditions promote IGSCC. These conditions are:

Stress - Normally found at welded joints

Environment - High electrochemical potential on metal surfaces

Susceptable Materials - Type 304 Stainless Steel Recirculation Piping is an example

Laboratory tests have shown that an environment with a controlled impurity concentration and a low dissolved oxygen concentration will reduce the ECP on a metal surface, and below a certain ECP stressed specimens of susceptable materials are immune to IGSCC.

The purpose of the HWC Program is to create this environment in an operating BWR and determine the parameters that would create IGSCC immunity.

History of HWC at Dresden Unit 2

The Electric Power Research Institute (EPRI) initiated a contract with Commonwealth Edison (ComEd) and General Electric (G.E.) to implement a one month HWC test at Dresden Unit 2 in 1982.

In order to implement this test, a temporary hydrogen supply line was run from behind the turbine building to the condensate booster pumps. Laboratory grade instrumentation manned by experts from G.E. was connected to temporary sample lines in order to monitor the important process parameters. This test system was equipped with a number of different automatic isolation features which provided assurance of fail-safe operation.

A temporary Technical Specification change for the MSLRM setpoints was requested for the duration of this test.

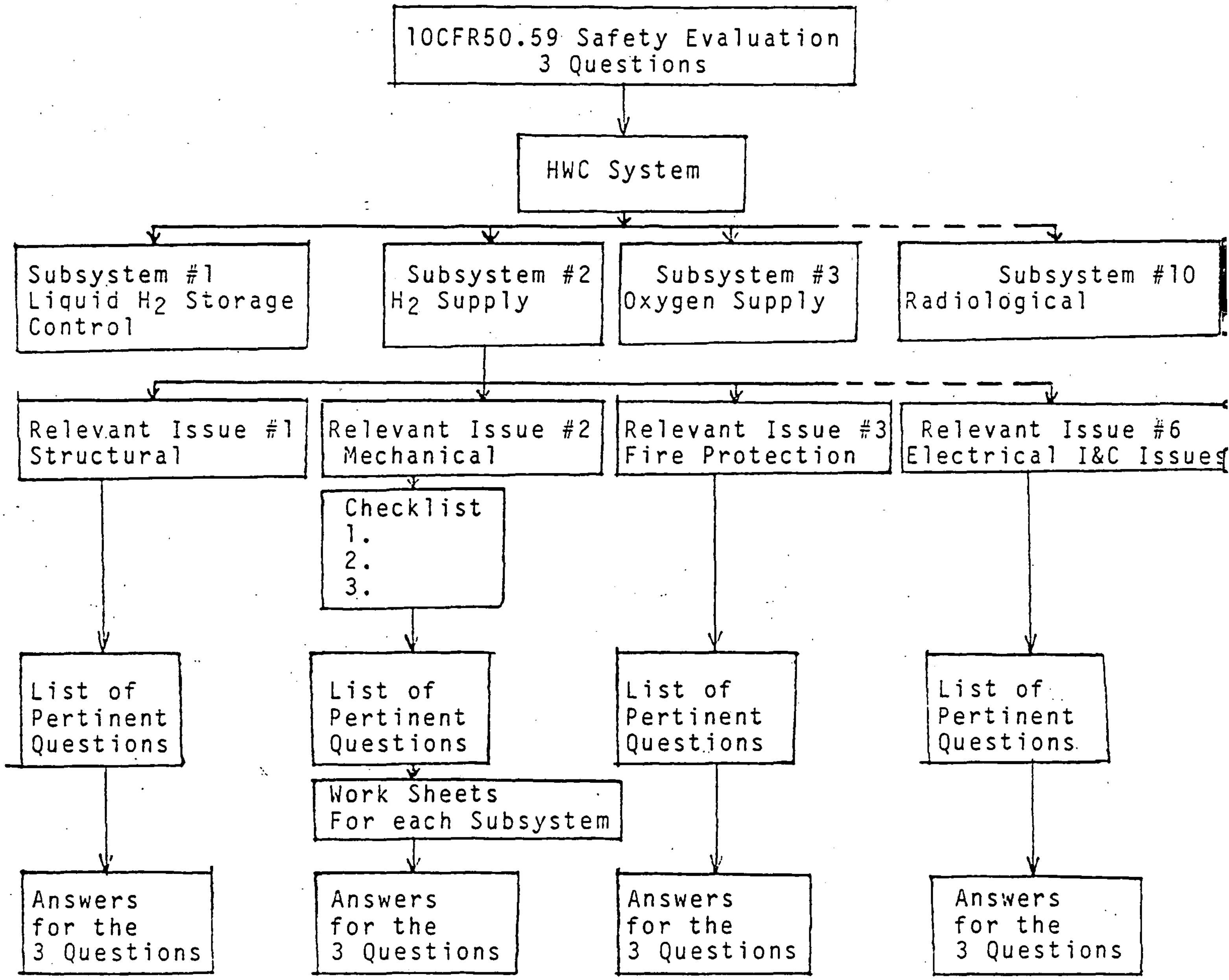
The results of this test showed that creating an environment that provided immunity from IGSCC was technically feasible.

Based on the positive results of the one month test, EPRI decided to negotiate a second contract with ComEd to implement a long term HWC Program. These negotiations took place during the Spring 1982 Dresden Unit 2 refueling outage. Due to the time constraints of the outage, upgrades to the temporary test system could not be completed before start-up. The decision was made to use the labor intensive temporary system for one cycle then install an industrial grade HWC system during refueling outage (Winter 84/85).

History of HWC at Dresden Unit 2

The single largest problem with the temporary HWC System is that hydrogen tube trailors had to be delivered at a rate of one per day to maintain the hydrogen flow requirements. An economic feasibility study concluded that a liquid hydrogen storage system would be the most cost-effective means of meeting the high hydrogen flow requirements. A modification was initiated to upgrade the HWC system and to install a liquid hydrogen storage system during the Winter 84/85 refueling outage.

HYDROGEN WATER CHEMISTRY
SAFETY EVALUATION SUMMARY



SAFETY EVALUATION:

1. Is the probability of an occurrence or the consequence of an accident, or malfunction of equipment important to safety as previously evaluated in the Final Safety Analysis Report increased?

2. Is the possibility for an accident or malfunction of a different type than any previously evaluated in the Final Safety Analysis Report increased?

3. Is the margin of safety, as defined in the basis for any Technical Specification, reduced?

HYDROGEN WATER CHEMISTRY SYSTEM
BREAKDOWN FOR SAFETY EVALUATION

1. Hydrogen Storage and Vaporization System

2. Oxygen Storage and Vaporization

3. Hydrogen Injection

4. Oxygen Injection

5. Sampling (Offgas)

6. Sampling (Recirc Line to Autoclaves)

7. Fire Protection (Including Hydrogen Detectors)

8. Instrumentation and Control (Including Panel and System Isolation/Shutoff)

9. Radiological Control

10. Hydrogen Delivery

RELEVANT ISSUES

- Site-Related Issues
- Mechanical Issues
- Structural Issues
- Electrical/I&C Issues
- Fire Protection Issues
- Radiological Issues

SAFETY EVALUATION GUIDELINES CHECKLIST

MECHANICAL ISSUES

No.	Relevant Issues		KEY WORDS	Justification if not relevant
1	✓	High energy line (sample line to autoclaves)	jet impingement, pipe whip	
2	✓	Internally generated missiles (parts of CERT autoclave)	pump rotor breakup, valve stem ejection	
3		Externally generated missiles (produced by tank explosion or failure)	tornado driven object, airplane	system failure cannot prod. a missile more severe than those evaluated in FSAR
M 4		Loose particles within piping systems or components	Thermowell, heat exchanger plugging, flow maldistributions	gaseous hydrogen or oxygen systems are not conducive to loose parts
M 5	✓	Deformation or catastrophic structural failure that could impair the safety function of the system, components or structures being modified, or other surrounding safety related systems	flow forces on valve stem causing maloperation, valves won't close, equipment support failure results in degradation of safety system	
M 6		Safety classification, compatibility of appendages or penetrations of safety related components such as vessels, or containments (sample line to autoclave)	change of RCIC (BWR) from non-safety related to safety related at containment penetration	dual isolation between safety-related and non-safety-related portions of the system is provid. proper safety classification is maintained
M 7		Double isolation where flow systems change safety classification (sample line to autoclaves)	containment isolation valves	
M 8	✓	Fail safe protection - safety function of the interfacing safety systems preserved upon failure (sample line to autoclave)	fail open, close, or as is	Isolation valves in sample lines to autoclaves fail in safe position; system isolation/shutdown is evaluated on worksheet B
M 9		Redundancy of existing systems reduced	backup system in FSAR affected	no reduction in redundancy of safety-related systems
M 10	✓	Environmental qualification (environmental qualification requires a separate evaluation) (higher dose near some equipment in x-area)	temperature, humidity, radiation environment	
M 11	✓	Seismic qualification (panel and tank)	maintain structural integrity; operate during, after seismic event	
M 12	✓	Compatibility of materials (combustibles, metals for H_2 and O_2 service) low feedwater O_2)	prohibited materials; excessive combustibles, sealants, coatings, insulation, effect of radiation, aluminum in containment restricted	impact of AWC on plant equipment materials is evaluated; piping materials & tank materials were designed (selected) for H_2 and/or O_2 service; failure of system itself does not jeopardize plant safety; ∴ no eval. req'd
M 13	✓	isolation between condensate & hydrogen lines; control of contamination		

"DON'T LIMIT YOUR CONSIDERATIONS AND THINKING TO THE ISSUES IDENTIFIED IN THIS CHECKLIST. THIS LIST IS TO SERVE AS A GUIDE AND AN AID IN YOUR EVALUATION."

SAFETY EVALUATION WORK SHEET

STATE THE ISSUE

1. Identify and list modification interfaces/interaction.

2. Define interfaces/interactions of mod with FSAR single failure events and DBAs

3. Are initial conditions and assumptions of FSAR accident analysis changes?

4. Are consequences bounded?

5. List failure modes and effect.

6. Are failure effects bounded or mitigated?

7. List Technical Specification interfaces/interactions with modification.

SAFETY EVALUATION WORKSHEET
HYDROGEN STORAGE & VAPORIZATION

ISSUES:

- S4: Protection of safety class structures from natural phenomena and meteorological conditions (tornados, rain loads, snow loads)
- ST3: Degradation of structural integrity of the existing structure (explosive load on structures)
- S6: Add potential hazards in the site or exclusion area (stored hydrogen)
- ST1: Seismic classification (panel and tank)
- M11: Seismic qualification (panel and tank)

IDENTIFY AND LIST MODIFICATION INTERFACES/INTERACTION:

Impact of potential failure on safety-related structures and equipment.

INTERFACES/INTERACTIONS of mod with FSAR single failure events and DBAs:

No impact on FSAR single failure events and DBAs.

Are initial conditions and assumptions of FSAR accident analysis changed?

NA

Are consequences bounded?

NA

List failure modes and effects:

Tank failure is limiting event. Failure modes:

1. Weld failure.
2. Overpressure failure
3. Natural phenomena (tornado missile is only design basis phenomenon capable of tank breach)

Are failure effects bounded or mitigated?

Yes. Based on probability and consequences of failure modes. See Refs. 1, 2.

List Technical Specification interfaces/interactions with modification:

No Technical Specification changes beyond those completed previously for the hydrogen mini-test are required.

Is Technical Specification margin of safety reduced?

No.

Does an unreviewed safety question exist?

No.

SAFETY EVALUATION WORKSHEET
HYDROGEN STORAGE & VAPORIZATION

ISSUES:
- S8: Stability of subsurface materials or foundations for class I structure (explosion causes seismic type forces through soil/rock to safety related structures)
- ST3: Degradation of structural integrity of the existing structure (explosive load on structures)

IDENTIFY AND LIST MODIFICATION INTERFACES/INTERACTION:

Impact of potential failure on safety-related structures.

INTERFACES/INTERACTIONS of mod with FSAR single failure events and DBAs:

No impact on FSAR single failure events and DBAs.

Are initial conditions and assumptions of FSAR accident analysis changed?

NA

Are consequences bounded?

NA

List failure modes and effects:

Tank failure by explosion could impart a seismic-type motion into soil and subsurface rock, which might be transmitted to safety-related structures.

Are failure effects bounded or mitigated?

Yes.

List Technical Specification interfaces/interactions with modification:

No Technical Specification changes beyond those completed previously for the hydrogen mini-test are required.

Is Technical Specification margin of safety reduced?

No.

Does an unreviewed safety question exist?

No.

HYDROGEN STORAGE AND VAPORIZATION SUBSYSTEM (HSVS)

Might the probability or consequences of accidents or malfunctions previously evaluated in the FSAR be increased?

No.

HSVS does not impact assumptions of any accident or single failure analyzed in the Dresden FSAR.

Might an accident or malfunction of a different type than previously evaluated in the FSAR be created?

No.

The limiting potential concern is liquid hydrogen tank failure.

This tank is capable of withstanding tornado winds and SSE loads.

The limiting design basis external event is tornado missile.

Overpressure protection devices.

Weld failure/tank operating conditions/fabrication QA

Low probability breach by a tornado missile, plus conservative vaporization, dispersion, and detonation assumption equals blast pressures below the structural design bases.

Negligible probability of blast effects beyond the plant design basis.

Ground motion negligible.

Might the margin of safety as defined in the basis for any technical specification be reduced?

No. The liquid hydrogen storage subsystem does not interact with any of the systems described in the technical specifications.

Conclusion

It should be apparent after going through this process that it was logical to conclude that an unreviewed Safety question did not exist.

Liquid Hydrogen Storage Tank Hazards Analysis

1. Determine the failure mode that would cause the most damage.

- plane crash
- vehicle collision
- exploding projectile

These senerios provide an ignition source that would result in a fire and not detonation.

- Instantaneous rupture of tank, loss of entire contents without ignition

Starting with this event, a senario can be developed where safety-related structures can be damaged.

Sequence of Events	Probability	Conservatism
• Tornado occuring in the vicinity	• $1 \times 10^{-4} yr^{-1}$	• Based on actual weather data with 50% factor of safety
• Missle causing large breach of tank	• 1×10^{-1} per tornado	• 3/4" carbon steel outer shell 1 ft perlite 3/4" alluminum inner shell Extremely difficult to puncture this tank, much less instantaneously spill its entire contents
• Wind blowing toward the plant	• 25%	• Wind generally blows from the Southwest. Most storms come from the Southwest. 25% is concervative

Sequence of Events	Probability	Conservatism
• Delayed Ignition	10%	• It would be very difficult to have delayed ignition after puncturing the tank. Other sources show this probability to be conservation
• Probability of Explosion rather than fire	.1 per ignition	• Quoted Source
• Damage to Safety-Related Structures.	$2.5 \times 10^{-8} \text{yr}^{-1}$	

Other Conservatisms

- Assume Tank is full at time of Rupture
- Most Concervative Gaussian diffusion model during a tornado
- Detonation of entire quantity in the flamable region resulting in 20% yeild
- Structure designed to 6.3 PSI static load not dynamic load.