GPU Nuclear

SAFETY ANALYSIS

SA # 4710-3220-86-0003

Rev. # 0

Page 1

of 7

TITLE

SAFETY ANALYSIS FOR ADDITION OF
BIOCIDE TO THE TMI-2 REACTOR COOLANT SYSTEM

Originator [signature] Date 5 MAY 1986

CONCURRENCE

Lead Engineer/RTR Robert F. J Date 5/5/86 SRG [signature] Date 5/5/86

Cognizant Eng. [signature] Date 5/5/86 Rad Con M.J. Slobodian Date 5-5-86

APPROVAL

Mgr. Eng. Section R.E. Gallagher Date 5/5/86 Site Ops Director [signature] Date 5/5/86

Mgr. Recovery Pgms. [signature] Date 5/5/86

FORM 4000-ENG-7310.09-1 (5/83)

8605080075 860505
PDR ADOCK 05000320
P PDR

SAFETY ANALYSIS FOR ADDITION OF BIOCIDE TO THE TMI-2 REACTOR COOLANT SYSTEM

Purpose and Scope:
The purpose of this safety analysis, is to demonstrate that the addition of the biocide hydrogen peroxide (H_2O_2) to the reactor coolant system (RCS) for disinfection of the biological species, will not result in any deleterious effect to the RCS chemistry or undue risk to the health and safety of the public. This safety analysis evaluates the pertinent issues involved with utilizing the biocide in the RCS; specifically, RCS technical specifications; criticality/boron dilution, and waste disposal.

Background:
Since initiation of defueling, the operation of the Defueling Water Cleanup System (DWCS) has experienced filter plugging. Review and analysis of RCS chemistry suggested four possible causes for filter plugging:

- o Biological species
- o Metal hydroxides or oxides
- o Silica
- o Hydrated borates

Additionally, laboratory analyses indicate that the RCS visibility and DWCS filter plugging difficulties are a combination of both inorganic and organic constituents.

Disinfection of biological species in the fuel transfer canal (FTC), and laboratory confirmation of microbiological systems as well as video inspections of RCS surfaces containing filamentous biota provides evidence for the existence of biological species in the RCS. Consequently, assessment of various biocides for use in controlling biological species has been the focus of considerable effort involving TMI-2 Site Organizations. This assessment has demonstrated hydrogen peroxide (H_2O_2) to be an effective biocide. In addition, other potential biocides are available and potentially viable; however, based on the desire for early use of a selected biocide, general chemical constraints associated with operating within current RCS technical specifications (reference 1), and general requirements that the biocide be compatible with existing RCS processing capabilities and defueling canisters, hydrogen peroxide was selected.

Disinfection:

Disinfection, as generally defined by Weber (reference 2), is a process in which organisms are destroyed or inactivated. This process may be accomplished by a number of different physiochemical treatments, including: thermal energy, ultraviolet, gamma, X-, microwave irradiation, ultrasonic disruption, and chemical agents with the latter the most common method of disinfection of waters and waste waters. The disinfection process, as practiced in water and waste water treatment, should be differentiated from the process of sterilization. The latter involves complete destruction or inactivation of all micro-organisms. Disinfection does not provide for destruction of all microorganisms.

The general chemical constraints on the RCS chemistry dictates a disinfection process. The biocide selected for use in the RCS is hydrogen peroxide. Hydrogen peroxide is a weakly acidic, clear colorless liquid, miscible with water in all proportions. It has a molecular weight of 34.01 g/gmole, and a specific gravity of about 1.44 at $25^{\circ}C$. It is a toxic material and precaution must be exercised to avoid skin contact or inhalation during handling. H_2O_2 is a powerful oxidizer, particularly in concentrated form and the TLV air is 1 ppm (DTLVS) for 90 vol.% H_2O_2. However, the bulk hydrogen peroxide at TMI-2 that will be used in preparing the make up solutions is 30 wt.%. Based on previous testing and experience, the recommended dosage of hydrogen peroxide in the RCS is 200 ppm in the contaminated fluid; however, application dosage may vary. The hydrogen peroxide will be added to the RCS in a batch manner from available tankage using RCS grade water as required to maintain up to approximately 200 ppm for disinfection. The makeup fluid containing hydrogen peroxide will be higher than 200 ppm dependent on makeup volume.

Compatibility

Biocide compatibility with RCS chemistry and processing capability is paramount in consideration for use in the RCS. Consequently, the following considerations have been addressed with regard to utilizing H_2O_2 as a disinfectant in the RCS:

- o Increased radionuclide release resulting from the oxidation capability of the H_2O_2.
- o Any deleterious effect to RCS processing capability, i.e. resins, zeolites.
- o Any deleterious effect to canister catalyst effectiveness.
- o Effect on RCS technical specifications

A review of radionuclide release rates for TMI-2 plant systems, (i.e. reactor coolant system (RCS) and fuel transfer canal (FTC)), and on Idaho National Engineering Laboratory (INEL) laboratory tests of core debris grab samples in RCS grade water with and without hydrogen peroxide has been made. These results indicate that hydrogen peroxide may increase the release rates approximately a factor of 2 to 10 times above presently observed accumulation rates. The factor of 2 is that observed by INEL and represents a realistic engineering estimate. The factor of 10 increase is that observed for the FTC and is a worst case estimate to establish the RCS clean up capability after hydrogen peroxide addition. Based on these increased accumulation rates, the addition of 200 ppm H_2O_2 to the RCS, will slightly increase fission product activity in the RCS; but this increase should have no measurable effect on Reactor Building airborne activities, gaseous release rates or offsite effects. In addition, RCS fission product activity is not expected to increase above activities previously observed in the RCS subsequent to head removal at which time dose rates above the IIF were 150 mrem/hour prior to installation of the shielded work platform and 15 mrem/hour on the shielded work platform. Furthermore, work on the defueling platform during and subsequent to the H_2O_2 addition will follow the radiological controls limitations found in the current defueling operations procedure.

The effect of the low concentrations (i.e. 200 ppm) of H_2O_2 on TMI-2 RCS resin/zeolite processing performance has been reviewed and evaluated. The general conclusion is that low levels of H_2O_2 will not seriously affect the performance or stability of the resin/zeolites. Further, H_2O_2 will have no effect on the diatomaceous earth filter operation. This conclusion is based on previous experience in the FTC.

The effect of the low concentration of H_2O_2 on the defueling canister catalyst effectiveness has been checked through laboratory testing. Catalyst performance was tested in the RHO laboratory with simulated TMI-2 RCS fluid at 500 ppm of H_2O_2 without lasting serious detrimental effects.

The elements of H_2O_2 pose no concern with respect to the RCS technical specifications. Additionally, routine laboratory analyses of the fuel transfer canal fluid after hydrogen peroxide had been added to control biological growth indicated no changes in boron concentrations; hence, it can be concluded that RCS boron concentration will be unaffected by H_2O_2. Given the low concentrations of hydrogen peroxide in the RCS the pH in the buffered RCS fluid will remain unchanged. Low concentrations of hydrogen peroxide are routinely used in reactor facilities as a method of removing "crud" from components; hence, corrosion of major reactor components is not a concern.

Personnel protection for handling H_2O_2 will be addressed in the appropriate plant procedures.

Boron Dilution:
The hydrogen peroxide addition will be effected through the use of RCS grade water to a resultant dosage of approximately 200 ppm. The volume of hydrogen peroxide required to provide a 200 ppm concentration is small compared to the RCS volume; therefore, the dilution of the boron content in the RCS is of no consequence.

Waste Disposal:
The waste disposal issues may be classified into radioactive and non radioactive. The radioactive classification involves the H_2O_2 added to RCS fluid (and other directly associated defueling fluids, RCBT-C, etc.) hence the disposal issue is for TMI-2 radioactive liquids not a separate issue from that for the RCS, RCBT-C, etc. fluids. While H_2O_2 is classified as a strong oxidizer, the low concentration of the H_2O_2 (i.e. 200 ppm) and generally rapid dissociation minimizes the concern. The non-radioactive classification involves any unused H_2O_2. This non-radioactive waste will

be disposed in accordance with GPU Nuclear Corporation Policy and Plan Manual in compliance with the Resource Conservation and Recovery Act (RCRA) Program at TMINS. This Plan manual provides TMINS compliance with State and Federal regulations. (reference 3).

10CFR50.59 Evaluation

10CFR50, Paragraph 50.59, permits the holder of an operating license to make changes to the facility or perform a test or experiment, provided the change, test, or experiment is determined not to be an unreviewed safety question and does not involve a modification of the plant technical specifications. This safety evaluation demonstrates that the probability of occurrence or the consequences of an accident or malfunction will not be increased during addition of H_2O_2 to the RCS. The safety evaluation also shows that the possibility of an accident of a different type than those evaluated in the TMI-2 FSAR will not be created since H_2O_2 is routinely used in operating facilities. Finally, the margin of safety as stated in the bases for the TMI-2 Technical Specifications will not be reduced since the addition of H_2O_2 will not affect existing Technical Specification limits. Therefore, it is concluded that the addition of H_2O_2 to the RCS does not present an unreviewed safety question as defined in 10CFR50, Paragraph 50.59. Additionally, no technical specification changes are required to perform the proposed activity.

Conclusion:

Consequently, it is concluded based on the foregoing discussion that hydrogen peroxide may be added to the TMI-2 RCS fluid without violating RCS technical specifications, involves no concern from a criticality/boron dilution view point, presents no deleterious effects on either the RCS processing capability or fuel canister catalyst, and constitutes no additional waste disposal considerations as waste disposal criteria/programs exist for handling both used and unused portions of this biocide. Therefore, utilizing the biocide presents no undue risk to the health and safety of the public.

REFERENCES

1. Three Mile Island Nuclear Station Unit 2 Operating License No. DPR-73 with the Recovery Technical Specifications; Section 4.0 Surveillance Requirements, Number 4.4.9 Pressure/Temperature Limits and Reactor Coolant System (page 4.4.1).

2. Walter J. Weber, Jr., Physiochemical Processes for Water Quality Control, John Wiley & Sons, New York (1972).

3. GPU Nuclear Corporation Policy and Plan Manual. The resource Conservation and Recovery Act Program at TMINS. TMINS Compliance with State and Federal Regulations: 1501-PLN-4541.01 (20 September 1985).