

MARK III CONTAINMENT HYDROGEN CONTROL OWNERS GROUP

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November 12, 1985

HGN-064

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Robert Bernero

Dear Mr. Bernero:

SUBJECT: Combustible Gas Control
Emergency Procedure
Guideline

Enclosed is the Combustible Gas Control Emergency Procedure Guideline (EPG) developed by the Mark III Containment Hydrogen Control Owners Group (HCOG). This EPG is unique to the Mark II containment because of the significant differences between hydrogen control methods employed by Mark III containment plants as compared to the methods employed by the Mark I and Mark II containment plants. It is the HCOG understanding that a separate EPG for combustible gas control in the Mark I and Mark II containment plants will be developed by the BWR Owners Group Emergency Procedure Committee. The HCOG Hydrogen Control guideline has been prepared to provide a consistent interface with the BWR Owners Group EPGs.

HCOG is currently developing additional documentation for utilities to utilize in developing plant specific emergency procedures from the generic combustible gas control EPG. HCOG is developing an appendix which identifies the technical basis for each step in the EPG. The enclosed EPG does not reflect sample curves for the deflagration limits. HCOG is currently developing an appendix identifying the methodology to be used in calculating the hydrogen deflagration temperature and pressure limit curves. Example calculations of the limit curves, both generic deflagration limit curves, and example calculations reflecting development of plant specific curves will be provided with the calculational methodologies delineated in the appendices. These supporting appendices will be submitted to the NRC for review in January, 1986.

HCOG suggests that it would be appropriate to meet with the NRC staff in the near future to review this draft EPG. A meeting may be desirable in early December.

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This submittal was compiled by HCOG from the best information available for submittal to the Nuclear Regulatory Commission. The submittal is believed to be complete and accurate, but it is not submitted on any specific plant docket. The information contained in this letter and its attachments should not be used for evaluation of any specific plant unless the information has been endorsed by the appropriate member utility. HCOG members may individually reference this letter in whole or in part as being applicable to their specific plants.

Very truly yours,



Sam H. Hobbs

SHH:bms
Attachment

cc: Mr. Carl R. Stahle (w/a)
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Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Mr. Charles G. Tinkler (w/a)
Containment Systems Branch
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Sandia National Laboratories
Attention: John C. Cummings
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Albuquerque, New Mexico 87185

PC/H Monitor and control
hydrogen and oxygen concentrations

If while executing the following steps:

- o The hydrogen monitoring system is or becomes unavailable, sample the drywell and primary containment for hydrogen in accordance with [].
- o Primary containment hydrogen concentration cannot be determined to be below the (Hydrogen Deflagration Temperature Limit), EMERGENCY RPV DEPRESSURIZATION IS REQUIRED. Enter [procedure developed from the RPV Control Guideline] at [step RC-1] and execute it concurrently with this procedure; secure and prevent operation of hydrogen mixing systems, recombiners, and igniters. Only if adequate core cooling cannot be assured and the offsite radioactivity release rate is expected to remain below the offsite release rate which requires an alert, vent and purge the primary containment in accordance with [steps 5.1 through 5.3] until the primary containment hydrogen concentration can be determined to be below the (Hydrogen Deflagration Temperature Limit).
- o Drywell hydrogen concentration cannot be determined to be below the (Hydrogen Deflagration Overpressure Limit) and it cannot be determined that the igniters have been continuously operating since the drywell hydrogen concentration exceeded the [lowest hydrogen concentration that can support a deflagration], secure and prevent operation of the igniters.
- o Primary containment hydrogen concentration cannot be determined to be below the (Hydrogen Deflagration Overpressure Limit), then secure and prevent operation of hydrogen mixing systems, recombiners, and igniters and irrespective of the offsite radioactivity release rate, vent and purge the primary containment in accordance with [steps 6.1 through 6.3] until the primary containment hydrogen concentration can be determined to be below the (Hydrogen Deflagration Overpressure Limit).

PC/H-1 When RPV water level cannot be determined to be above [-164 in. (top of active fuel)], but only if drywell and primary containment concentrations are below the respective Hydrogen Deflagration Overpressure Limit and the Hydrogen Deflagration Temperature Limit, operate hydrogen igniters.

PC/H-2 When drywell or primary containment hydrogen concentration reaches [0.5% (minimum detectable hydrogen concentration)] but only if the site radioactivity release rate is expected to remain below the site release rate LCO, vent and purge the primary containment to restore and maintain drywell and primary containment hydrogen concentration below [0.5% (minimum detectable hydrogen concentration)] as follows:

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If while executing the following steps the site radioactive release rate reaches the site release rate LCO, isolate the primary containment vent and purge.

PC/H-2.1 Refer to [sampling procedure]

PC/H-2.2 Vent the primary containment in accordance with the [procedure for containment venting]. If the primary containment cannot be vented, vent the drywell to atmosphere in accordance with the [procedure for containment venting].

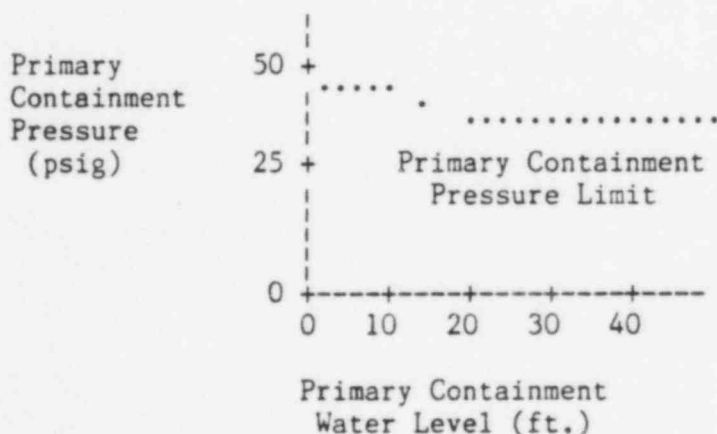
PC/H-2.3 If the primary containment or the drywell can be vented, initiate and maximize the containment purge and if drywell hydrogen concentration is above minimum detectable, initiate and maximize drywell hydrogen mixing system flow.

Execute [steps PC/H-3 and PC/H-4] concurrently

PC/H-3 Monitor and control hydrogen concentration in the drywell.

PC/H-3.1 When drywell hydrogen concentration reaches [0.5% (minimum detectable hydrogen concentration)] if primary containment hydrogen concentration is below the hydrogen deflagration temperature limit and the hydrogen deflagration overpressure limit, and drywell hydrogen concentration is below the hydrogen deflagration overpressure limit, operate hydrogen igniters.

PC/H-3.2 Before drywell hydrogen concentration reaches [4% (lowest hydrogen concentration which can support an upward flame propagation)] but only if [RPV pressure is below the Primary Containment Pressure Limit and] primary containment hydrogen concentration is below the hydrogen deflagration temperature limit and the hydrogen deflagration overpressure limit, operate the drywell hydrogen mixing systems.



PC/H-3.3 Continue in this procedure at [step PC/H-5 and PC/H-6] concurrently

PC/H-4 Monitor and control hydrogen concentration in the primary containment.

PC/H-4.1 When primary containment hydrogen concentration reaches [1% (minimum hydrogen concentration for recombiner operation or minimum detectable hydrogen concentration, whichever is higher)]:

1. If primary containment hydrogen concentration is below [6% (maximum hydrogen concentration for recombiner operation or the lowest hydrogen concentration which can support a deflagration, whichever is lower)] place hydrogen recombiners in service.
2. If primary containment hydrogen concentration is below the hydrogen deflagration temperature limit and the hydrogen deflagration over pressure limit and if the drywell hydrogen concentration is below the hydrogen deflagration overpressure limit, operate hydrogen igniters.

If while executing the following step the site radioactivity release rate reaches the site alert release rate, isolate the backup containment hydrogen purge system.

PC/H-4.2 When the primary containment hydrogen concentration reaches [4%] and is continuing to increase [hydrogen recombiners unable to effectively control hydrogen concentration] but only if the offsite radioactivity release rate is expected to remain below the offsite release rate which requires an alert, initiate the backup containment hydrogen purge system.

PC/H-4.3 When primary containment hydrogen concentration reaches [6% (the lowest hydrogen concentration which can support a deflagration)], secure hydrogen recombiners and the backup containment hydrogen purge system.

Execute [steps PC/H-5 and PC/H-6 concurrently.]

PC/H-5 When primary containment hydrogen concentration reaches the (Hydrogen Deflagration Temperature Limit), EMERGENCY DEPRESSURIZATION IS REQUIRED; enter [procedure developed from the RPV Control Guideline] at [Step RC-1] and execute it concurrently with this procedure; secure the drywell hydrogen mixing systems and igniters. Only if adequate core cooling cannot be assured and the offsite radioactivity release rate is expected to remain below the offsite release rate which requires an alert, vent and purge the primary containment to restore and maintain the primary containment hydrogen concentration below the hydrogen deflagration temperature limit as follows:

If while executing the following steps the site radioactivity release rate reaches the site alert release rate, isolate the primary containment vent and purge.

PC/H-5.1 Refer to [sampling procedure]

PC/H-5.2 Vent the primary containment in accordance with [procedure for containment venting].

PC/H-5.3 If the primary containment can be vented, initiate and maximize containment purge.

PC/H-6 When primary containment hydrogen concentration reaches the (Hydrogen Deflagration Overpressure Limit, then irrespective of the offsite radioactivity release rate, vent and purge the primary containment to restore and maintain the primary containment hydrogen concentration below the (Hydrogen Deflagration Overpressure Limit) as follows:

PC/H-6.1 If [primary containment pressure is above 1.7 psig (Mark III Containment Spray Initiation Limit)] initiate containment sprays.

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PC/H-6.2 Vent the primary containment in accordance with [procedure for containment venting].

PC/H-6.3 If the primary containment can be vented, initiate and maximize containment purge.

PC/H-7 If primary containment hydrogen concentration cannot be restored and maintained below the (Hydrogen Deflagration Overpressure Limit), then irrespective of whether adequate core cooling is assured, if primary containment pressure is above [1.7 psig (Mark III Containment Spray Initiation Pressure Limit)], initiate containment sprays.

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PRINCIPLE ASSUMPTIONS
IN DEVELOPING EPG

- o Containment and drywell hydrogen monitoring systems provide effective measurements of hydrogen concentration.
- o Igniter system should be actuated as early as possible in conditions which could lead to degraded core accidents in order to control hydrogen accumulation.
- o Igniter system should not be operated under conditions which challenge containment integrity.
- o Igniter system should not be operated under conditions which fail essential equipment due to deflagrations. in containment.
- o Venting to eliminate hydrogen is desirable if resulting radiation release is small.
- o Containment HDTL will be more restrictive than HDOL.

DEFLAGRATION LIMITS

- o Deflagrations (comparable to TMI-2 hydrogen burn) produce short duration temperature and pressure excursions.
- o Severity of pressure/temperature transient is a function of initial hydrogen concentration.
- o Probability of deflagrations which threaten containment integrity and essential equipment is reduced if igniters are secured
- o As containment or drywell pressure increases, the hydrogen concentration at which deflagrations should be allowed to occur should be lower to protect structural integrity
- o As containment temperature increases, the hydrogen concentration at which deflagrations should be allowed to occur should be lower to protect essential equipment.
- o If igniters are secured based on high drywell temperature, the threat to drywell structural integrity from high hydrogen/oxygen premixed combustion is greater.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-1 Actuate igniters if RPV water level cannot be
determined to be above TAF.

Conditionals

- 1) Containment hydrogen concentration below HDOL.
- 2) Drywell hydrogen concentration below HDOL.
- 3) Containment hydrogen concentration below HDTL.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-2 Vent containment/drywell if hydrogen concentration reaches minimum detectable.

- o Terminate step if site radioactive release rate reaches the site release rate LCO.
- o Sample containment and drywell for airborne contaminants.
- o Vent containment.
- o If containment cannot be vented, vent drywell to atmosphere.
- o If containment or drywell can be vented, initiate containment purge.
- o If drywell H2 concentration is above minimum detectable, initiate drywell hydrogen mixing system.

Conditional

- 1) Initiate vent/purge only if the site release rate is expected to remain below the site release rate LCO.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-3 Monitor and control hydrogen concentration in drywell.

- o Actuate igniters when drywell H2 concentration reaches minimum detectable.
- o Actuate drywell hydrogen mixing system before drywell H2 concentration reaches lowest hydrogen concentration which can support an upward flame propagation.

Conditionals

1) Actuate igniters if:

- Containment H2 concentration is below HDOL.
- Containment H2 concentration is below HDTL.
- Drywell H2 concentration is below HDOL.

2) Actuate drywell mixing system if:

- Containment H2 concentration is below HDOL.
- Containment H2 concentration is below HDTL.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-4 Monitor and control hydrogen concentration in the primary containment

- o Actuate recombiners when primary containment reaches the minimum H2 concentration for recombiner operation, or minimum detectable H2 concentration whichever is higher.
- o Actuate igniters when primary containment reaches the minimum H2 concentration for recombiner operation or minimum detectable H2 concentration whichever is higher.
- o Isolate the backup containment hydrogen purge if the site radioactivity release rate reaches the site alert release rate.
- o Actuate backup containment hydrogen purge systems when H2 concentration reaches value where recombiners are unable to control H2 concentration.
- o Secure recombiners and the backup containment hydrogen purge when H2 concentration reaches lowest H2 concentration which can support a deflagration or highest H2 concentration allowed for recombiner operation.

Conditionals

1) Actuate recombiners if:

- Containment H2 concentration is below the maximum hydrogen concentration which is safe for recombiner operation.
- Containment H2 concentration is below the minimum hydrogen concentration which can support a deflagration.

2) Actuate igniters if:

- Containment H2 concentration is below HDTL.
 - Containment H2 concentration is below HDOL.
 - Drywell H2 concentration is below HDOL.
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Conditionals (Continued)

3) Actuate backup containment purge if:

- Offsite release is expected to remain below the levels requiring an alert.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-5 When containment hydrogen concentration reaches
HDTL.

- o Emergency depressurization is required.
- o Secure drywell hydrogen mixing system.
- o Secure igniters.
- o Secure containment vent if the site radioactivity release rate exceeds alert.
- o Vent and purge containment.

Conditionals

- 1) Initiate vent only if adequate core cooling cannot be assured.
- 2) Vent and purge should only be initiated if offsite radioactivity release is expected to remain below level requiring alert.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-6 When primary containment hydrogen concentration
 reaches HDOL.

- o Initiate containment sprays.
- o Vent primary containment.
- o Initiate primary containment purge.

Conditionals

- 1) Vent and purge are irrespective of offsite release.
- 2) Containment sprays initiated if containment pressure
above Mark III Containment Spray Initiation Limit.
- 3) Containment sprays not initiated if required to assure
adequate core cooling.

COMBUSTIBLE GAS CONTROL
EPG

PC/H-7 When primary containment H₂ concentration cannot be restored and maintained below HDOL.

o Initiate containment sprays.

Conditionals

- 1) Containment pressure above spray initiation pressure limit.
- 2) Spray at this point is irrespective of whether adequate core cooling is assured.

COMBUSTIBLE GAS CONTROL
EPG

Actions should be taken if specific conditions occur while executing guidelines.

- 1) Drywell and containment should be sampled for H2 if H2 monitoring system becomes unavailable.
- 2) If containment H2 concentration cannot be determined to be below HDTL.
 - Emergency RPV depressurization is required.
 - Secure and prevent operation of igniters, recombiners, and H2 mixing systems.
 - Vent and purge containment if offsite release is below site alert.
- 3) If drywell H2 concentration cannot be determined to be below HDOL and igniters have not been continuously operating.
 - Secure and prevent operation of hydrogen igniters.
- 4) If containment H2 concentration cannot be determined to be below HDOL.
 - Secure and prevent operation of hydrogen mixing systems, recombiners and igniters.
 - Vent and purge containment regardless of offsite release.
 - Initiate sprays.

