Instructions for Inserting
Revision 4 of the

Hydrogen Control Program Plan

Replace	existing	page	4-8	with	page	4-8	dated	10/29/85
Replace	existing	page	4-17	with	page	4-17	dated	10/29/85
Replace	existing	page	4-26	with	page	4-26	dated	10/29/85
Replace	existing	page	4-33	with	page	4-33	dated	10/29/85
Replace	existing	page	4-40	with	page	4-40	dated	10/29/85
Insert	new	page	4-40a	after	page	4-40	dated	10/29/85
Replace	existing	page	4-42	with	page	4-42	dated	10/29/85
Replace	existing	page	4-69	with	page	4-69	dated	10/29/85
Insert	new	page	4-69a	after	page	4-69	dated	10/29/85
Replace	existing	page	4-83	with	page	4-83	dated	10/29/85
Replace	existing	page	4-91	with	page	4-91	dated	10/29/85
Insert	new	page	4-91a	after	page	4-91	dated	10/29/85
Replace	existing	page	4-96	with	page	4-96	dated	10/29/85
Insert	new	page	4-96a	after	page	4-96	dated	10/29/85
Replace	existing	page	4-97	with	page	4-97	dated	10/29/85
Replace	existing	page	4-98	with	page	4-98	dated	10/29/85
Replace	existing	page	4-99	with	page	4-99	dated	10/29/85
Insert	new	page	4-99a	with	page	4-99	dated	10/29/85
Replace	existing	page	4-100	with	page	4-100	dated	10/29/85
Replace	existing	page	4-101	with	page	4-101	dated	10/29/85
Insert	new	page	4-101a	after	page	4-101	dated	10/29/85
Replace	existing	page	4-102	with	page	4-102	dated	10/29/85
Replace	existing	page	4-103a	with	page	4-103	dated	10/29/85
Replace	existing	page	4-111	with	page	4-111	dated	10/29/85
Replace	existing	page	4-112	with	page	4-112	dated	10/29/85
Replace	existing	page	4-113	with	page	4-113	dated	10/29/85
Replace	existing	page	4-115	with	page	4-115	dated	10/29/85
Replace	existing	page	4-125a	with	page	4-125a	dated	10/29/85
Replace	existing	page	4-128	with	page	4-128	dated	10/29/85
Insert	new	page	4-128a	after	page	4-128	dated	10/29/85
Replace	existing	page	4-129	with	page	4-129	dated	10/29/85
Replace	existing	page	4-133	with	page	4-133	dated	10/29/85
Insert	new	page	4-133a	after	page	4-133	dated	10/29/85
Replace	existing	page	4-134	with	page	4-134	dated	10/29/85
Replace	existing	page	4-138	with	page	4-138	dated	10/29/85
Replace	existing	page	4-140	with	page	4-140	dated	10/29/85
Replace	existing	page	4-141	with	page	4-141	dated	10/29/85
Replace	existing	page	4-142	with	page	4-142	dated	10/29/85
Insert	new	page	4-142a	with	page	4-142	dated	10/29/85
Replace	existing	page	4-144	with	page	4-144	dated	10/29/85
Replace	existing	page	4-145	with	page	4-145	dated	10/29/85
Replace	existing	page	4-153	with	page	4-153	dated	10/29/85
Replace	existing	page	4-154	with	page	4-154	dated	10/29/85
Replace	existing	page	4-158	with	page	4-158	dated	10/29/85
Replace	existing	page	4-159	with	page	4-159	dated	10/29/85
Replace	existing	page	4-164	with	page	4-164	dated	10/29/85

Insert new page 4-164a after page 4-164 dated 10/04/85
Replace existing page 4-168 after page 4-168 dated 10/04/85
Replace task 1 network with new network dated 10/04/85
Replace task 5 network with new network dated 10/04/85
Replace page 2 of task 9 with new network dated 10/04/85
Replace page 1 of task 10 with new network dated 10/04/85
Replace page 2 of task 10 with new network dated 10/04/85
Replace page 11 network with new network dated 10/04/85
Replace page 13 network with new network dated 10/04/85
Replace existing Milestone Schedule with new schedule dated 10/04/85

additional work requested by the NRC staff was submitted to the NRC as an attachment to HGN-006 dated September 9, 1982.

Responsiblity - HCOG
Status - Complete

1.6 Evaluate ATWS and SBO Accident Scenarios

The work under task 1.4 was completed in late 1982 and early 1983. Since that date, additional information within the nuclear industry has been developed on the probability of Anticipated Transients Without Scram (ATWS) and Station Blackout (SBO) Events. The HCOG committed to submit a qualitative]4
discussion concerning the omission of ATWS and SBOs as HGE]4
initiators due to the low probability of either event leading to recoverable degraded core accidents which threaten containment integrity due to hydrogen combustion. This discussion has been provided to the NRC staff for review by letter]4
HGN-055 dated September 27, 1985.]4

Responsibility - HCOG
Status - Complete]4

operations shall not adversely affect systems and components needed for safe operation of the plant.

4. The mitigation system shall prevent accumulation of hydrogen to detonable mixtures under conditions conducive to combustion following a hydrogen generation event.

5. The hydrogen mitigation system shall not endanger the health and safety of the public due to planned or inadvertent actuation and shall meet the requirements of 10CFR100 as applicable.

6. The hydrogen mitigation system shall be capable of demonstrating its operability by periodic surveillance tests.

7. The hydrogen mitigation system shall be capable of maintaining the containment integrity in the environment present in the Mark III containment after a hydrogen generation event. The mitigation system shall be environmentally and seismically qualified or capable of being qualified in accordance with the requirements of IEEE-323 and IEEE-344 as applicable.

]4
]4
]4

adversely affect component operation. If the igniter device must be submerged or subject to pool swell, the component must be designed to withstand the anticipated submergence or pool swell impact loads. The effects of high energy pipe whip and jet impingement shall be considered.

4. The operating temperature for the igniter device must assure reliable ignition of hydrogen at low concentrations. A minimum surface temperature of 1700°F at an applied voltage of 12.0v for the igniter glow plug shall be acceptable to meet this requirement. A minimum surface temperature of 1500°F will be maintained at a minimum voltage of 10.8v.

5. The hydrogen ignition system shall be sufficiently redundant to assure that no single active or passive failure will prevent the system from performing its intended function. The ignition system shall be divided into divisional subsystems powered from redundant onsite and offsite emergency safeguard feature power supplies. In enclosed regions of the containment which may be susceptible to pocketing of hydrogen, separate igniters powered from redundant power supplies shall be installed.

6. The hydrogen ignition system shall have the capability to be initiated prior to onset of hydrogen production. Manual initiation of the system shall be acceptable provided that guidance is available to the operator on system initiation procedures. A minimum of 10 minutes shall be available between the time when the vessel level reaches the top of the active fuel and the time when siginificant hydrogen production begins for the hydrogen generation events identified in Task 1.]4

7. The hydrogen mitigation system shall be designed as seismic Category I system and in accordance with IEEE-344 and shall be

ACCEPTANCE CRITERIA FOR TASK 4
CONTAINMENT ULTIMATE CAPACITY ANALYSIS

1. The containment structural integrity shall be established by analyzing the ultimate internal pressure capacity. The ultimate internal pressure capacity shall be defined as that pressure where a general state of yield is reached by the limiting structural section or component. Local components such as containment air lock and hatch seals, and penetrations shall be shown to maintain their structural integrity at pressures which equal or exceed the ultimate internal pressure capacity.

2. The calculational method for determining ultimate internal pressure capability may include the use of actual material properties with suitable margins to account for uncertainties in modeling, in material properties, in construction tolerances, and so on. Another method which can be used is to demonstrate the following specific criteria of the ASME Boiler and Pressure Code are met:

A. Steel containments shall meet the requirements of the ASME Boiler and Pressure Vessel Code Section III,
Division 1, Subarticle NE-3220, Service Level C Limits,]4
considering pressure and dead load alone. The evalua-]4
tion of instability is not required.]4

B. Concrete containments shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 2, subarticle CC-3720, Factored Load Category, considering pressure and dead load alone.

3. For containments which do not have vacuum breakers to admit additional air mass into the containment volume, the containment structure shall be demonstrated to withstand an external

5.9 Prepare CLASIX-3 Verification Report

The efforts which have been completed to verify the CLASIX and CLASIX-3 programs provide substantial assurance that these codes reasonably predict deflagration combustion in the containment following an accident which releases large quantities of hydrogen. Complete details of this verification process were prepared by OPS and included in the CLASIX and CLASIX-3 Topical Reports. Verification reports included numerous hand calculations, comparisons of particular code models with other accepted codes and an independent verification of the suppression pool model.

Reponsibility - OPS
Status - Complete

5.10 Submit CLASIX-3 Verification Report to NRC

A report describing the CLASIX-3 code was prepared for the Hydrogen Control Owners Group by Westinghouse and submitted to the NRC. This report, titled, "The CLASIX-3 Computer Program for the Analysis of Reactor Plant Containment Response to Hydrogen Release and Deflagration", was submitted to the NRC as an attachment to HGN-009 dated March 19, 1983.

Responsibility - HCOG
Status - Complete

5.11 Validation of CLASIX-3 Against NTS Data]4

In a February 12, 1985 HCOG/NRC meeting, HCOG had indicated that]4
CLASIX-3/NTS comparisons were unnecessary. This is due to NTS]4

being only a single compartment facility whereas the Mark III]4
containment, which CLASIX-3 was developed to model, is a]4
multicompartment facility. Also, NTS included minimal heat]4
sinks while the Mark III containments modeled with CLASIX-3 have]4
substantially greater amounts of heat sinks. However, NRC's]4
July 8, 1985 letter suggested HCOG complete these comparisons.]4
HCOG has completed a limited validation of CLASIX-3 against NTS]4
data and found that CLASIX-3 provides generally conservative]4
predictions of pre-mixed combustion tests.]4

Responsibility - HCOG]4
Status - Complete]4

5.12 Submit Report Detailing Validation of CLASIX-3 Against NTS Data to NRC]4]4

A limited validation of CLASIX-3 against the data obtained from]4
NTS has been performed. HCOG will provide the results of this]4
validation to the NRC.]4

Responsibility - HCOG]4
Status - Not Started]4

energy addition rates shall be controlled by external input parameters such as ignition criteria, burn time, and completeness of burn. Control volumes may be assumed to be perfectly mixed.

4. The containment response analysis code used to evaluate effects of hydrogen control system operation shall be compared with other accepted containment response analysis codes. This comparison shall show that the selected containment response analysis code predicts containment response in agreement with predictions of accepted codes. The suppression pool modeling shall be shown to represent the behavior of the Mark III suppression pool.

5. The containment response analysis code used to evaluate effects of hydrogen control system operation shall be compared with large scale test data relevant to the Mark III containment. This comparison shall be completed in accordance with the acceptance criteria identified for Task 12.

6. The containment response analysis code used to evaluate]4
effects of hydrogen control system operation shall be validated]4
against data from the Nevada Test Site program. The code shall]4
be demonstrated to provide conservative results with regards to]4
the temperature and pressure decay in the NTS vessel.]4

scale test facility should represent the most probable hydrogen generation event. This event entails loss of core inventory, failure of all makeup systems, core heatup, hydrogen production and termination of the event by recovery of a large flow ECCS. Another hydrogen release history used in the 1/4 scale facility should be a release history which results in a limiting diffusion flame thermal environment. This release history must be produced by a system which would be available during a degraded core event. The event should produce sustained diffusion flames. A third hydrogen release history should be used to validate the containment response analysis code selected under task 5. Selection of hydrogen release histories for inclusion in the 1/4 scale test program was initially documented in letter HGN-031 dated March 13, 1985.

During a meeting between the HCOG and the NRC staff on May 22, 1985, the HCOG committed to modify the hydrogen release histories which will be used in the 1/4 scale production testing in task 9.23. The HCOG agreed to include the 75% MWR hydrogen release history calculated in subtask 7.15 in the 1/4 scale test program. The HCOG also agreed to modify the "A" and "B" hydrogen release histories identified in HGN-031 so that the total amount of zircaloy in the active core region which is allowed to melt will be 50% instead of 30%.

By letter dated June 24, 1985 the NRC Staff proposed hydrogen release histories different from those proposed by HCOG in previous correspondence. The staff indicated that the following release histories would be acceptable. Case "A" calculated with an injection rate of 150 gpm at 3100 sec., similar to that documented in run HCOG 23 in letter HGN-018, Case "B" calculated with an injection rate of 5000 gpm at 50% zircaloy melt, and Case "C" consisting of Case "A" with a constant 0.1 lbm/sec release following the Case "A" hydrogen release until the total amount of hydrogen released equaled a 75% metal water reaction.]4

In their letter dated July 8, 1985 the NRC staff stated that]4
HCOG should recalculate the release histories after revising the]4
BWRCHUC to account for latent heat of fusion of zircaloy in the]4
core. These release histories were provided to the staff by]4
letter HGN-052 dated 8/1/85. The NRC staff accepted these]4
release histories in their letter dated 8/16/85. The HCOG will]4
use these release histories for the 1/4 scale test program.]4

ACCEPTANCE CRITERIA FOR TASK 8
CONTAINMENT RESPONSE ANALYSIS

1. Analyses to evaluate the consequences of hydrogen release to the containment, from a metal-water reaction of up to 75% of the fuel cladding surrounding the active fuel region, shall be conducted. The analysis shall specifically address effects produced by operation of the hydrogen control system.

2. Accidents involving hydrogen release to the drywell and to the suppression pool shall be evaluated. Assumptions regarding containment and drywell initial conditions shall be based upon realistic assumptions. This analysis shall include the period from the time of occurrence of the initiating event until substantial challenges from hydrogen combustion to containment]4
integrity and equipment survivability are abated.]4

3. A containment response code and meeting the acceptance criteria for Task 5 shall be used to analyze the containment pressure and temperature response.

4. Hydrogen combustion parameters used for containment analysis shall have sufficient supporting information to justify their use. The following parameter values are acceptable for containment analysis:

A.	Minimum hydrogen volume fraction required for ignition.	0.06
B.	Minimum hydrogen volume fraction to support flame propagation.	0.06
C.	Hydrogen fraction burned (Burn completeness)	0.65

anticipated the Nuclear Regulatory Commission staff would request additional information on the facility's goals, design and use. Several Requests for Additional Information (RAI) were received by HCOG on December 8, 1983 and responses were provided in letter HGN-016 dated April 2, 1984. In addition, other questions relating to the facility have been addressed to the Hydrogen Control Owners Group during the meeting identified in
Subtask 9.4.]4

The HCOG has submitted letter HGN-054 dated August 28, 1985]4
concerning the use of vertical blockage in the 1/4 scale test]4
facility. In that letter HCOG had indicated that for plant]4
configurations which have containment sprays a net 100% blockage]4
would be installed in the facility, except in the chimney in]4
which the equipment hatch is located. Letter HGN-049 concerning]4
the 1/4 scale test test facility igniter placement and]4
containment thermocouple temperature response and location was]4
prepared in response to several informal questions from an NRC]4
representative and was submitted on August 28, 1985.]4

The development of responses to the Nuclear Regulatory Commission staff has had impact on the facility goals, design and use. Therefore, feedback from this activity to program elements 9.1 and 9.2 is shown.

Responsibility - HCOG
Status - In Progress

9.6 Construct Test Facility

The 1/4 scale test facility is being constructed for HCOG by the Electric Power Research Institute (EPRI) and Factory Mutual Research Corporation (FMRC). Initial construction was started

in August, 1983 and was completed in January, 1985. The 1/4 Scale Test Facility is located at FMRC's remote test site in West Gloucester, Rhode Island. Planning and construction control was provided by FMRC with EPRI retaining overall management and budget authority.

into the final design report. The role of a complex geometry calorimeter provided by the Hydrogen Control Owners Group will also be discussed in the final document. This activity will be completed concurrently with other Subtasks. The start of scoping or production tests will not be delayed for this activity.

Responsibilty - HCOG
Status - Not Started

9.15 Submit Final Design Report to NRC Staff

The report documenting the design and configuration of the facility as used for testing will be submitted by the Hydrogen Control Owners Group to the Nuclear Regulatory Commission staff. The Nuclear Regulatory Commisssion staff has been apprised of all facility changes by various HCOG/NRC meetings. This Subtask will provide a reference for facility design features.

Responsibility - HCOG
Status - Not Started

9.16 Finalize Scoping Test Matrix

The scoping test matrix for the 1/4 scale test facility had]4
originally included 14 separate tests. The parameters to be]4
addressed by the tests are discussed below in subtask 9.17. The]4
hydrogen release histories to be used for the tests were also]4
determined. Both were transmitted to NRC by letter HGN-031]4
dated March 13, 1985. The NRC staff had identified questions on]4
HCOG's proposed scoping test matrix and release histories. In]4
addition, as a result of testing completed to date, HCOG has]4
modified the proposed final scoping test matrix. A revised test]4

matrix was discussed with the NRC during a meeting on July 17,]4
1985 and documented to the NRC by letter HGN-053 dated August 1,]4
1985 and revised hydrogen release histories were provided by]4
letter HGN-052 dated August 1, 1985. The NRC provided comments]4
on HCOG's final scoping and production test matrices in a letter]4
dated August 16, 1985. Based on these comments and suggestions]4
made in the July 17, 1985 meeting between HCOG and NRC, HCOG]4
completed three additional scoping tests. A final scoping test]4
matrix will be provided to document completion of the scoping]4
testing.]4

Responsibility - HCOG
Status - In Progress

9.17 Complete Scoping Tests

Seventeen scoping tests are being performed to confirm the]4
effect of important parameters which affect the definition of
the diffusion flame thermal environment. The following paramet-]4
ers or goals are being addressed by scoping tests:]4

- Data repeatability
- Threshold for establishing continuous diffusion flames
- Effect of concurrent steam and hydrogen injection
- Simultaneous discharge through LOCA vents and spargers
- Effect of grating near suppression pool surface on the combustion transients
- Defining the thermally limiting 75% MWR hydrogen]4
  release history]4
- Effect of securing a large number of igniters]4
- Validation of CLASIX-3]4

A complete set of test data is being recorded for each scoping]4
test.]4

The matrix identified in subtask 9.16 has been completed.]4
However, the HCOG is performing three additional tests to]4
investigate concerns raised by the NRC. A test to investigate]4
the effect of having a large number of igniters inoperable was]4
performed based on comments made by the NRC staff during a]4
meeting with HCOG on July 17, 1985. Two low flow rate tests to]4
validate CLASIX-3 were performed in response to NRC's August 16,]4
1985 letter.]4

Responsibility - FMRC
Status - In Progress

9.18 Analyze Scoping Test Results

The HCOG made several specific assumptions for the proposed production test matrix. These assumptions are:

- The effects of hydrogen released through the spargers is limiting compared to releasing hydrogen through both the LOCA vents and spargers

- Effects of injecting steam and hydrogen simultaneously is negligible when compared to releasing hydrogen alone

]4
]4
]4

- No hydrogen pocketing will occur in the facility.

The results from the scoping tests have been initially analyzed]4
to determine if these assumptions are correct. This preliminary]4
analysis was presented to NRC by letter HGN-053 dated 8/1/85. A]4
final report summarizing the scoping tests will be provided.]4

Responsibility - EPRI/FMRC
Status - In Progress

9.19 Production Test Matrix Acceptable?

A comparison of planned production tests and the scoping tests]4
was completed to determine if any modifications to the produc-]4
tion test matrix were necessary based on scoping test results.]4
It was found that modifications to the production test matrix]4
were required. The assumptions identified in Task 9.18 have]4
been reviewed against scoping test results. Based on this review]4
HCOG decided to include additional tests in the matrix. These]4
tests concern the addition of tests with hydrogen injected]4
through SRV spargers and LOCA vents, and a full set of produc-]4
tion tests with the facility in a Perry configuration. A late]4

input from Subtask 9.25 after formal submittal of scoping test]4
results has resulted in a revision of the production test matrix]4
in order to reflect resolution of Nuclear Regulatory Commission]4
questions and concerns.]4

Responsibility - HCOG
Status - Complete]4

9.20 Revise Production Test Matrix

Since the comparison of scoping test results and the production]4
test matrix did not validate all of the assumptions used to]4
generate the original production test matrix, the production]4
test matrix has been revised. A revision to the production test]4
matrix was provided to the NRC by letter HGN-053 dated August 1,]4
1985. In an August 16, 1985 letter as well as during a]4
September 5 meeting, the NRC stressed the need for a production]4
test matrix that reflected additional tests to determine the]4
thermal environment produced by hydrogen combustion when the]4
containment sprays are not operable. By letter HGN-060 dated]4
10/29/85 HCOG transmitted a revised test matrix to address the]4
concerns of the NRC staff. This revised matrix reflects an]4
increased number of tests to be completed without operating the]4
simulated containment sprays.

Responsibility - HCOG
Status - Complete]4

9.21 HCOG/NRC Meeting to Review Scoping Test Results

HCOG had a meeting on July 17, 1985 with the Nuclear Regulatory]4
Commission staff to discuss scoping test results from Subtasks]4
9.17 and 9.18 and conclusions regarding adequacy of the produc-]4

tion test matrix. The production test matrix was revised after]4
this meeting and provided to the staff by letter HGN-053 dated]4
8/1/85.]4

Responsibility - HCOG
Status - Complete]4

9.22 HCOG/NRC Meeting to Review Production Test Progress

The Hydrogen Control Owners Group will meet with the Nuclear Regulatory Commission staff during production testing to review test progress and to discuss problems encountered during testing. Information concerning the nature of combustion will be provided including indications of the severity of thermal environment measured during the tests.

Responsibility - HCOG
Status - Not Scheduled

9.23 Complete Production Test

After the production test matrix is finalized in Subtask 9.20,
production testing will be authorized to proceed. A matrix]4
including twenty-nine production tests was transmitted by letter]4
HGN-060 dated 10/29/85. These tests will be conducted for four]4
different facility geometries reflecting the containment]4
arrangements of Perry Nuclear Power Plant, Grand Gulf Nuclear]4
Station, Clinton Power Station, and River Bend Station. The tests for River Bend Station will include containment cooler effects. The following parameters will be addressed by production tests:

- Variation in containment geometry
- Variation in location of assumed stuck open SRV
- Absence of containment sprays
- Thermal environment produced by most probable HGE
- Thermal environment produced by discharging hydrogen through LOCA vents and SRV spargers

Data from the first series of tests in the Perry Nuclear Power]4
Plant geometry will be used as early input to Subtask 11.7 to]4
obtain a definition of the diffusion flame thermal environment.
Data from this Subtask will also be used in Subtask 12.6, 12.8,
12.9,12.10, and 12.15 to aid in validation of the analytical
methods used in the survivability analysis program.

Responsibility - EPRI/FMRC
Status - Not Started

9.24 Submit Preliminary Scoping Test Results

The scoping test data has been organized and correlated into a]4
preliminary scoping test report and was submitted to the Nuclear]4
Regulatory Commission by letter HGN-053 dated 8/1/85. This]4
served to document the Hydrogen Control Owners Group's conclusions regarding the parameters investigated during scoping
tests. Changes to the production test matrix to reflect the]4
observed behavior of the facility were addressed in this]4
submittal. Final scoping test data evaluations will be included
in a Final Scoping Test Report which will be submitted to]4
augment the report submitted by letter HGN-053.]4

Responsibility - HCOG
Status - In Progress]4

9.25 Resolve Questions on Scoping Test Results

The Nuclear Regulatory Commission staff's detailed review of the]4
scoping test data report generated questions which were]4
documented to HCOG in a letter dated August 16, 1985. These]4

questions could affect the production test matrix. Feedback to Subtask 9.19 to reflect any late changes in the production test matrix is considered a part of this task element. The Hydrogen Control Owners Group will also generate responses to any Nuclear Regulatory Commission staff questions regarding the scoping tests as part of this activity.]4

Responsibility - HCOG
Status - In Progress]4

9.26 Complete Data Reduction

The initial production test data from the Perry Nuclear Power]4
Plant containment geometry will be reduced to allow an early]4
definition of the diffusion flame thermal environment in order
to support various plant licensing proceedings. The data will
be used as input to the evaluation of equipment survivability.
Data from remaining tests for Clinton, River Bend, and Grand]4
Gulf will also be reduced for use in Subtask 11.7 to define]4
their respective diffusion flame thermal environments. Also,
the completion of data reduction will aid in the resolution of
questions on the diffusion flame thermal profiles in Subtask
11.10.

Responsibility - EPRI/FMRC
Status - Not Started

9.27 HCOG/NRC Meeting To Discuss Production Test Data

A meeting with the Nuclear Regulatory Commission to review the reduced data and data reduction methodology will be held when production test data results and correlations are complete. This meeting will provide early input to the Nuclear Regulatory Commission staff and support continued use of the data for definition of diffusion flame thermal environments for the specific plants.

Responsibility - HCOG
Status - Not Scheduled

9.28 Prepare Final Test Report

A 1/4 scale program final test report will be prepared documenting the tests and data reduction performed under Subtasks 9.17, 9.23 and 9.26. The report will contain a

9.31 Verify Adequacy of 1/4 Scale Heat Loss Modeling

The HCOG has evaluated the theoretical comparative heat losses]4
between the test facility and the full scale Mark III plants. A
study has been completed to estimate the heat losses from the]4
1/4 scale test facility to heat sinks in the facility and to the
facility structures versus heat losses to full scale plant
equipment and heat sinks. This study was performed to assure]4
that the gas temperatures measured in the 1/4 scale facility
will be conservative or comparable to the temperature which
would be produced in a full scale plant. The intent of the
study is to show that the Froude modeled 1/4 scale test facility
provides an acceptable representation of temperatures in a full
scale facility. This study was provided to the NRC staff for]4
review in letter HGN-037 dated July 28, 1985.]4

The staff identified concerns over the agreement between the 1/4]4
scale test facility data and the heat loss report predictions.]4
HCOG is revising predictions of the facility response by using]4
actual hydrogen release histories and assuming combustion]4
initiation and conclusion at observed times. HCOG will also]4
evaluate other factors which influence predictions, such as]4
background gas heat loss correlations, and heat loss correla-]4
tions for plumes. HCOG will apprise the NRC staff of the]4
results of the additional investigation.]4

Responsibility - FMRC/EPRI
Status - In Progress

10.5 Select Code For Blowdown Analysis

Since a new analysis to predict drywell blowdown under degraded core conditions was determined to be required from Subtask 10.3 a survey of appropriate codes was conducted and the MAAP code was selected to perform the required analyses. The MAAP code has been used in the IDCOR program to calculate responses of the plant to degraded core accidents. The hydrogen production module in MAAP has been benchmarked against the BWR Core Heatup Code. This approach should limit questions on the selection and use of this code. MAAP will be used at Subtask 10.6 to conduct predictions of blowdown to the drywell under degraded core accident sequence assumptions prior to depressurization of the primary system.

Responsibility - HCOG
Status - Complete

10.6 Complete Blowdown Analysis

Using realistic drywell initial conditions, the selected break sizes, and accident sequences leading to degraded core conditions, a drywell blowdown analysis up to the point at which the vessel is depressurized has been completed using the MAAP code]4
selected in Subtask 10.5. This analysis defined the time]4
history of break flow into the drywell including mass added to the drywell, energy added to the drywell, and temperature response until the reactor vessel is depressurized by the operator.

Responsibility - HCOG
Status - Complete]4

10.7 Define ADS Timing

Flow through a postulated drywell break will continue until the
reactor is depressurized by the operator using the ADS. The
time that ADS actuation will occur depends on the operator's]4
response to action limits in the emergency procedures based on
drywell temperature, reactor vessel level, and suppression pool
heat capacity, among other parameters. The operator is expected
to maximize the time available before hydrogen production using
steam cooling. HCOG also evaluated the effect of actuating ADS]4
at its automatic setpoint which is based on reactor pressure]4
vessel level reaching Level 1. Before hydrogen production]4
commences, the vessel will be fully depressurized. This
establishes the point where hydrogen and steam production from
the degraded core can be predicted by the BWR Core Heatup Code.
The hydrogen and steam flow is split between the open ADS SRVs
and the drywell break after the vessel is depressurized using
the ADS.

Responsibility - HCOG
Status - Complete]4

10.8 Calculate Drywell Break-SRV Flow Split

The division of steam and hydrogen between the drywell break and
the open SRVs is affected by the drywell pressure history after]4
ADS, the number of ADS valves open, suppression pool level, the
reactor vessel pressure, the break size, and the timing of ADS.
Based on these factors, a realistic flow split of hydrogen and
steam has been determined. Using the steam and hydrogen release]4
history generated as part of subtask 7.15, a blowdown history of
steam and hydrogen through the break into the drywell has been]4
calculated. This blowdown history of steam and hydrogen and the
pre-ADS steam blowdown history from 10.6 will be used to define
the steam and hydrogen release history to the drywell from the
time of break until core recovery is completed. This composite

release history will be used as input to analyze the drywell thermal response in Subtask 10.9.

Responsibility - HCOG
Status - Complete]4

10.9 Analyze Drywell/Containment Pressure Using CLASIX-3

The CLASIX-3 program is a multi-compartment containment response analysis code which will predict temperature, pressures and concentrations of gases. To represent a drywell break, a time history of the steam, hydrogen and fission product energy along with associated enthalpies must be input into the code. This is provided by Subtasks 7.15 and 10.8 for this analysis. Emergency procedure actions determined from Subtask 13.10 will also be used for this analysis. To determine if deflagrations in the drywell are possible, the CLASIX-3 code or other acceptable deflagration analysis code will be run for the drywell and containment using the blowdown history from Task 10.8 and appropriate combustion parameters for the drywell. The analysis will account for the effects of drywell bypass leakage on the wetwell and upper containment response. If deflagrations occur then the effect of this drywell pressure spike will be determined. This analysis will also allow the Hydrogen Control Owners Group to determine if inverted diffusion flames can be established at the exit of the CGCS compressor or from other oxygen sources in the drywell. The results from this analysis will define the environment which equipment in the drywell must survive if the Hydrogen Control Owners Group concludes that inverted diffusion flames do not occur in the drywell. Thus, this Subtask provides input to Subtask 11.6 in the equipment survivability analysis program. The resolution of Nuclear Regulatory Commission staff questions from Subtask 10.11 concerning this analysis will be assessed to determine their impact on this Subtask. Since previous CLASIX-3 runs have not

10.12 Define Criteria For Existence Of Inverted Diffusion Flames

The existence of inverted diffusion flames has been investigated]4
by determining the appropriate conditions required to support
this phenomena. This included required hydrogen concentration]4
in the drywell, oxygen content of the entering gas, effect of
combustion products, local mixing, location and geometry of air
inlet sources to the drywell, water vapor effects. A search of
existing combustion literature for applicable test data defining
the parameters needed to support inverted diffusion flames was
conducted. This information was used to define a conservative]4
set of conditions and criteria which must be present in order
for inverted diffusion flames to exist. This criteria will be
used by Subtask 10.13 to determine if degraded core accident
conditions in the drywell can support this type of hydrogen
combustion.

Responsibility - HCOG
Status - Complete]4

10.13 Determine If Inverted Diffusion Flames Can Occur

Using the drywell environment produced by Subtask 10.9 and the criteria defined in Subtask 10.12, it will be determined if drywell conditions support existence of inverted diffusion flames at the point(s) of air entry into the drywell. As part of this task, a survey to identify all systems which can introduce air into the drywell or hydrogen into the containment other than through the LOCA vents or SRV spargers will be conducted. The air entry points into the drywell or drywell exits will be described and assessed for the ability to produce continuous flames. If continuous diffusion flames are determined not to exist, then this information will be used in

existing experimental data and analytical techniques or from a suitable test. Drywell essential equipment exposed to a potential inverted diffusion flame environment will be shown to meet the acceptance criteria of Task 11.

6. The pool swell transient shall be defined based upon
expected combustion in the drywell. Drywell and containment
structures and components shall be evaluated to determine that
pool swell does not impose structure, equipment or support
loadings greater than previously analyzed. This may be
accomplished by demonstrating that pool swell loads do not exist
or that pool swell loads are enveloped by the present design
loads, or that essential structures and components survive the
pool swell event. The LOCA design basis drywell to containment
pressure differential will be compared to the differential
pressure transient produced by hydrogen combustion. The HCOG]4
intends to evaluate both negative and positive pool swell based]4
on the wetwell to drywell differential pressure history. No]4
pool swell loadings will be evaluated if the drywell to contain-]4
ment differential pressure (either positive or negative) for]4
design basis events exceed the hydrogen combustion differential
pressure for the length of the transient.

11.1 Criteria For Equipment Survivability

The criteria used to determine if a piece of essential equipment
in the containment or drywell survives a degraded core hydrogen
combustion event are based on the current equipment
qualification program conducted in accordance with NUREG-0588.
If the pressure spike or differential pressure to which a]4
component is exposed, as determined from containment deflagra-]4
tion analysis acceptable per criteria identified in Task 8,is
below the static qualification pressure, the equipment is deemed
acceptable. The equipment is also deemed acceptable if it can]4
be shown to be insensitive to pressure increases during a]4
hydrogen burn. If the surface temperature response of a]4
component to hydrogen combustion is above the qualification
temperature and the temperature rise of the critical component
is below its qualification temperature, the equipment is
expected to survive. If the temperature qualification envelope
does not bound the temperature rise of the critical component
due to hydrogen combustion, other measures must be applied as
determined in Subtask 11.18 to assure survivability.

Responsibility - HCOG
Status - Complete

11.2 Identify Equipment Required To Survive

A generic list of equipment required to survive a degraded core accident resulting in hydrogen production has been prepared by the Hydrogen Control Owners Group. Five criteria were used in the selection of this equipment:

(1) Systems and components required to maintain the core in a safe shutdown condition

(2) Equipment and structures required to maintain the integrity of the containment pressure boundary

(3) Equipment and systems which must function to mitigate the consequences of the event

(4) Instrumentation and systems which will be used to monitor the course of the event and provide guidance to the operator for initiating actions in accordance with the Emergency Procedures Guidelines

(5) Components whose failure could preclude the ability of the above systems to fulfill their intended function

The generic equipment list has been given to each Hydrogen Control Owners Group member utility for guidance in developing plant specific equipment lists.

Responsibility - HCOG
Status - Complete

11.3 Select Survivability Analysis Code

A computer code capable of analyzing the thermal response of a piece of equipment subjected to transient heat fluxes due to thermal radiation, convective heat transfer and conductive heat
transfer has been selected. The code also analyzes internal]4
convection and radiation. The code is capable of solving]4
complex geometries in various coordinate systems. The ability to input the variable heat flux at component boundaries due to the dynamic thermal environment was also required. HEATING-6 was selected by HCOG to perform the required analyses.

Responsibility - HCOG
Status - Complete

11.4 Establish Components To Be Analyzed

Plant specific lists of equipment required to survive these transients have been established based on the criteria identified in subtask 11.1, and have been reviewed to identify common components. In addition, the physical geometry of similar components was reviewed to determine if a single heat transfer model can be used to represent a variety of similar components. Finally, if two similar pieces of equipment were

profiles. The thermal response for each piece of equipment will be predicted. Generic analysis will be completed by the Hydrogen Control Owners Group to the greatest extent possible. The methodology for generic analysis will be discussed with the Nuclear Regulatory Commission staff in Subtask 11.9. Questions resulting from this presentation and resolved in Subtask 11.10 will be assessed for possible impact on this Subtask. In addition, resolution of questions on the validation process in Subtask 12.12 will act as input to this task.

Responsibility - HCOG/Utility
Status - Not Started

11.12 Peak Pressure Exceeds Equipment Qualification Pressure

The peak pressure in the containment or drywell, as appropriate, established in Subtasks 8.13 and 10.27 will be compared against the pressure that each piece of essential equipment identified in Subtask 11.2 is qualified to withstand by its environmental qualification documentation. If the peak pressure is less than the environment qualification pressure then the equipment is acceptable and this will be documented in the plant specific equipment survivability report. If the peak pressure exceeds the pressure it was previously qualified for, it will be further
evaluated in Subtask 11.13. Also, the potential differential]4
pressure defined from the containment deflagration analyses]4
acceptable per criteria identified in Task 8 will be evaluated]4
to assure that the piece of equipment exposed to differential]4
pressure transients has sufficient design margin to survive the]4
potential differential pressure transients. If the component]4
has adequate design margin, the equipment is acceptable. If]4
there is insufficient design margin for the component, it will]4
be further evaluated in Task 11.13.]4

Responsibility - HCOG/Utility
Status - Not Started

11.13 Document Equipment Survival

The equipment design will be reviewed for sensitivity to pressure transients if the environmental qualification pressure is exceeded by the peak pressure expected from hydrogen

combustion. It will be demonstrated that equipment will survive
the predicted pressure spikes and differential pressure trans-]4
ients which exceed the qualification pressure. The results of]4
this evaluation will be documented in the equipment survivabil-
ity report prepared by each utility as part of Subtask 11.21.

Responsibility - Utility
Status - Not Started

11.14 Peak Temperature Exceeds Equipment Qualification Temperature

If the peak surface temperature of the equipment as predicted by the survivability analysis at Subtask 11.11 is below the qualification temperature when evaluated using the appropriate thermal profiles generated in Subtasks 11.6, 11.7 and 11.8, then the equipment response is acceptable, and this conclusion will be documented in the equipment survivability report as part of Subtask 11.21. If the peak temperature of the equipment exceeds the environmental qualification temperature, then further analysis will be conducted as part of Subtask 11.15 to determine if the equipment survives and can perform its required function.

Responsibility - HCOG/Utility
Status - Not Started

11.15 Identify Critical Component

For each piece of equipment in Subtask 11.14 for which the thermal response exceeds the environmental qualification temperature, a review of the equipment qualification documentation will be conducted. This review will identify the

11.22 Submit Survivability Report To NRC

The generic survivability report prepared by the Hydrogen Control Owners Group will be given to each member utility. Each member utility will be responsible for submitting to the Nuclear Regulatory Commission staff the plant specific report prepared under Subtask 11.21 which documents the equipment survival of plant specific equipment and equipment analyzed generically by the Hydrogen Control Owners Group.

Responsibility - HCOG/Utility
Status - Not Started

11.23 Assure Components Reach Peak Temperature in Qualification]4
Profile]4

In a January 31, 1985 HCOG/NRC meeting HCOG had indicated that]4
qualification testing for BWR's occurs over a long period of]4
time. Components have ample time to reach thermal equilibrium]4
with the test environment. NCR staff's July 8, 1985 letter]4
stated the staff's concerns regarding temperatures reached]4
during qualification testing by the equipment surface or the]4
equipment's most sensitive component. HCOG members will review]4
environmental qualification temperature profiles to assure]4
components should be expected to attain the peak temperature for
an adequate length of time during qualification testing.

Responsibility - HCOG/Utility]4
Status - Not started]4

component will not compromise plant safety or adversely affect the performance of equipment required to survive hydrogen combustion, then the component will not be required to survive these accidents.

2. The equipment and its internal component temperature responses will be calculated using an accepted heat transfer code. This code shall be capable of solving steady-state and transient heat conduction problems including radiant heat transfer in one, two and three dimensional cartesian or cylindrical coordinates. The analysis code shall be capable of
analyzing time dependent boundary conditions. The code shall]4
treat convection and radiation internal to equipment.]4

Equipment models shall be based on equipment drawings and manufacturer's data which account for the as-installed orientation and mounting arrangement. Models shall be constructed considering the most appropriate coordinate system, component materials, internal heat generation, internal volumes or air spaces, and specific thermal properties of the materials of construction. Boundary conditions shall be established for all conducting surfaces.

3. The number of components to be modeled and/or analyzed may be limited if one of the following criteria is met:

A. The identical component model has been previously analyzed with a more limiting thermal environment and found to be acceptable.

B. A similar, more thermally responsive component model, has been determined to provide conservative thermal response results which meet the survivability criteria. Components may be judged to be similiar if the thermal mass of two components, materials for two components,

and overall geometry for two components can be shown to be comparable or conservative.]4

4. The thermally limiting component shall be a component or subassembly of a piece of equipment required to survive hydrogen combustion which is determined most likely to fail during a hydrogen combustion temperature transient.

5. Thermal environments produced by deflagrations, diffusion flames and inverted diffusion flames shall be defined for the locations of equipment required to survive these transients. The deflagration thermal environment shall be defined based on containment response analysis produced in Task 8. The diffusion flame thermal environment shall be defined by scaling up of test data from appropriate tests in the 1/4 scale test facility and meeting the acceptance criteria identified in Task 9. The inverted diffusion flame thermal profile for the drywell shall be defined based upon experimental data or analyses using the acceptance criteria identified in Task 10. All of the thermal profiles shall be defined based on realistic experimental data or analyses. Factors of conservatism need not be applied to the definition of the thermal environments.

6. Equipment and components shall have demonstrated the ability to survive a hydrogen burn temperature transient if one of the following criteria is met:

A. The equipment surface temperature is equal to or below the equipment qualification temperature.

B. If the surface temperature exceeds the equipment qualification temperature, then the equipment or component will survive a hydrogen burn if the temperature response of the most thermally limiting component is equal to or below the component qualification temperature.

C. The equipment surface temperature is equal to or below the equipment survivability temperature. The survivability temperature shall be defined as a temperature, higher than the qualification temperature, at which the equipment has been demonstrated to operate by analyses or testing.

Component qualification temperature shall consider the period of time that a component is maintained at a specific temperature.

7. Equipment and components shall demonstrate the ability to survive a hydrogen burn pressure transient by meeting one of the following criteria:

A. The equipment experiences a peak pressure as determined]4
from containment deflagration analysis acceptable per]4
criteria identified in Task 8, below the equipment qualification pressure.

B. The equipment can be shown to be insensitive to
pressure increases experienced during a hydrogen burn]4
event.]4

C. Components such as drywell vacuum breakers or hydrogen]4
mixing system compressors which may be exposed to]4
differential pressure transients must have sufficient]4
design margin to accomodate the potential differential]4

pressure defined from the containment deflagration]4
analyses acceptable per criteria identified in Task 8.]4

8. If a piece of equipment or critical component cannot be shown to survive, then measures shall be identified to assure survivability. These measures may include but are not limited to:

A. Protecting the component by use of:
   1) Shields
   2) Insulation
   3) Cooling

B. Replacing the component with equipment which will survive the hydrogen burn environment.

C. Relocating the component to a milder environment

12.1 Develop CLASIX-3 Model of 1/4 Scale Test Facility

A specific CLASIX-3 input case using the 1/4 scale test facility will be developed. The modeling of the 1/4 scale test facility may be considered an extension of the code verification completed under subtask 5.8. The specific treatment of geometry, compartment volumes, heat sinks, spray flow, spray carryover, intercompartment connections and other features of the 1/4 test facility must be determined in order to obtain an accurate model. This information will be used in Subtask 12.2 to specify an appropriate input case.

Responsibility - GMF
Status - In Progress

12.2 Specify CLASIX-3 Input

The steam and hydrogen flows, compartment initial conditions, burn parameters, flow path parameters, spray system parameters, heat sinks, and suppression pool level, must be determined to define an input case for CLASIX-3. Where appropriate, the same assumptions used in previous containment response analyses will be used in the 1/4 scale test predictions. For example, hydrogen combustion in a compartment will be initiated when bulk compartment hydrogen concentration reaches 8% and 85% of the hydrogen in the compartment will be assumed to burn. At least one analysis will also be completed with best estimate combustion parameters such as assuming combustion is initiated when compartment hydrogen concentration reaches 6% with 65% of the hydrogen being burned.]4

Responsibility - HCOG
Status - In Progress

12.3 Complete CLASIX - 3 Prediction

Using the CLASIX-3 model of the 1/4 scale test facility developed in Subtask 12.1 and the input data file from Subtask 12.2 a test prediction of the 1/4 scale test facility response will be made. This run will predict the containment gas temperatures, constituent gas concentrations, and containment pressure response for the deflagration event in the 1/4 scale test faclity.

Responsibility - GMF
Status - In Progress]4

12.4 Design Complex Calorimeter

A complex calorimeter has been designed and installed in the test facility. The complex calorimeter represents different types of equipment geometries such as rectangular and cylindrical components. It also has several different materials with a variety of coupled thermal masses. This device is sufficently instrumented to measure its response to the convective and radiant heat flux present in the facility. The ability to move the calorimeter to various locations in the 1/4 scale test facility has been provided in order to measure the change in total heat flux as the distance from hot gas plumes is increased. Design details on the complex calorimeter, its location in the facility, and instrumentation near the calorimeter were supplied to the NRC staff in letter HGN-027 dated February 13, 1985.

Responsibility - EPRI
Status - Complete

TASK 13 - COMBUSTIBLE GAS CONTROL EPG

A complete set of symptom based emergency procedure guidelines (EPG) has been developed by the Emergency Procedure Committee (EPC) of the BWR Owners Group as part of the BWR Owners Group's response to NUREG-0737. The Hydrogen Control Owners Group has been working to develop a new symptom based guideline which will]4
direct the operator's actions when hydrogen is or may be present in the containment or drywell.

This task describes the work which has been completed by HCOG in support of EPG development and future work which must be completed. Part of this effort will involve a thorough comparison of the operator actions based upon the final EPG against the operator actions assumed in licensing analyses and test programs conducted to evaluate degraded core accidents. Various asrumptions regarding operator actions have been made in the testing program to define the containment diffusion flame thermal environment, the analyses to define the containment deflagration thermal environment, the analyses used to calculate hydrogen release rates and the analyses to define the effects of degraded core accidents on the drywell.

13.1 Draft Emergency Procedure Guideline

The Hydrogen Control Owners Group has been working to draft an]4
emergency procedure guideline for hydrogen control. The]4
hydrogen control EPG will direct operator actions regarding use of hydrogen igniters, drywell hydrogen mixing systems, thermal recombiners and containment venting. The guideline is being written to assure that containment structural integrity is maintained and that equipment which is required to survive these transients remains functional for hydrogen combustion as deflagrations.

Responsibility - HCOG]4
Status - In Progress

13.2 Develop Procedure For Calculating Action Limits

The present draft version of the combustible gas control EPG utilizes two limit curves to assure that primary containment structural integrity is maintained and that equipment which is required to survive these transients remains functional for hydrogen combustion as deflagrations. The Hydrogen Deflagration Overpressure Limit (HDOL) curve assures that probability of intentional hydrogen combustion is minimized when such combustion might result in failure of the primary containment structure. The Hydrogen Deflagration Temperature Limit (HDTL) curve assures that the probability of intentional hydrogen combustion is minimized when such combustion might result in failure of equipment which is required to survive these transients. The Hydrogen Control Owners Group has developed a procedure for calculating these limit curves using the CLASIX-3

13.9 Determine Spray Timing

The present primary containment EPG directs the operator to
actuate containment sprays on high containment temperature if
adequate core cooling is assured. The HCOG has estimated when]4
containment sprays would be actuated based upon the thermocou-
ples which would be used to define bulk average temperature, the
response time for the thermocouples and the time required for
the spray pumps to deliver water to the spray headers. The
thermal environment predicted with a hydrogen combustion]4
analysis code was used to calculate the temperature response of
the thermocouples. The time required to actuate containment
sprays will be used in the 1/4 scale test procedures to control
spray actuation in the test. This information will be used in
Subtask 9.10 to develop test procedures.

Responsibility - HCOG
Status - Complete]4

13.10 Review Assumptions in Analysis and EPG

A number of assumptions have been made concerning operator actions in developing the 1/4 scale tests, completing analyses of deflagrations and analyzing the drywell response to degraded core accidents. The operator actions assumed should either correspond to operator actions identified in the combustible gas control EPG or the operator actions assumed in the analysis should result in conservative analysis results. The purpose of this subtask is to assure non-conservative assumptions regarding operator actions have not been made. If any changes in assumed operator actions must be made, these changes will be fed back into the 1/4 scale test program at Subtask 9.9, the definition

of the deflagration thermal environment at Subtask 8.8, the analysis of the drywell response to degraded core accidents at Subtask 10.9, and the definition of assumptions for calculation of hydrogen release histories at Subtask 7.7.

Responsibility - HCOG
Status - Not Started

13.11 Meeting to Discuss EPG and Assumptions

A meeting will be held between the Hydrogen Control Owners Group]4
and the Nuclear Regulatory Commission to discuss the final]4
combustible gas control guideline and its effect on licensing analyses. The basis for each step in the guideline will be reviewed. Finally, any changes in assumptions used in licensing analysis will be identified.

Responsibility - HCOG
Status - Not Scheduled

13.12 Resolve Questions on EPG and Analysis

It is anticipated that the final combustible gas control EPG and the analysis at Subtask 13.10 may result in questions or requests for additional information from the NRC staff. The purpose of this subtask is to provide resolution of any questions. Responses to questions or requests for additional information will be prepared and submitted to the Nuclear Regulatory Commission staff.

Responsibility - HCOG
Status - Not Started

concentrations exceeding the values allowed by the hydrogen
ignition system may have produced thermal environments harsher
than expected in the Mark III containment after a degraded core
hydrogen generation event. The temperature versus time]4
profiles for premixed hydrogen combustion tests will be compared]4
with base code predictions of the Mark III containment response]4
to hydrogen combustion which are in accordance with acceptance]4
criteria of task 8. Also equipment installed in the hydrogen]4
test dewar will be reviewed to determine if it is representative
of any equipment used by the HCOG members.

Responsibility - HCOG
Status - In Progess

14.4 Determine Equipment Which Failed and Cause

The NTS equipment data will be examined to determine which items of equipment applicable to HCOG member plants failed and the apparent failure mechanisms. If a report addressing a particular equipment failure is available, then this report will be consulted. If no information is available, the installation of the component, the stated capabilities of the component and other relevant data will be analyzed to determine if equipment failure occurred as a result of hydrogen combustion.
Responsibility - HCOG
Status - In Progress

14.5 Identify Any Differences Between Licensing Assumptions and NTS Results

The conclusions derived from the NTS test series will be reviewed against the assumptions used for the Hydrogen Control

Owners Group CLASIX-3 analysis. Specific differences identified in subtask 14.5 will be evaluated for their effect on previous analytical work performed by the Hydrogen Control Owners Group. This information will be used in Subtask 8.8 to determine if additional generic CLASIX-3 containment response analyses with

ACCEPTANCE CRITERIA FOR TASK 14
NEVADA TEST SITE DATA EVALUATION

1. Data obtained by EPRI from a series of tests conducted in a large scale hydrogen dewar and intended to provide generic information on the performance and thermal response of selected nuclear plant equipment under a range of hydrogen burn environments shall be evaluated.

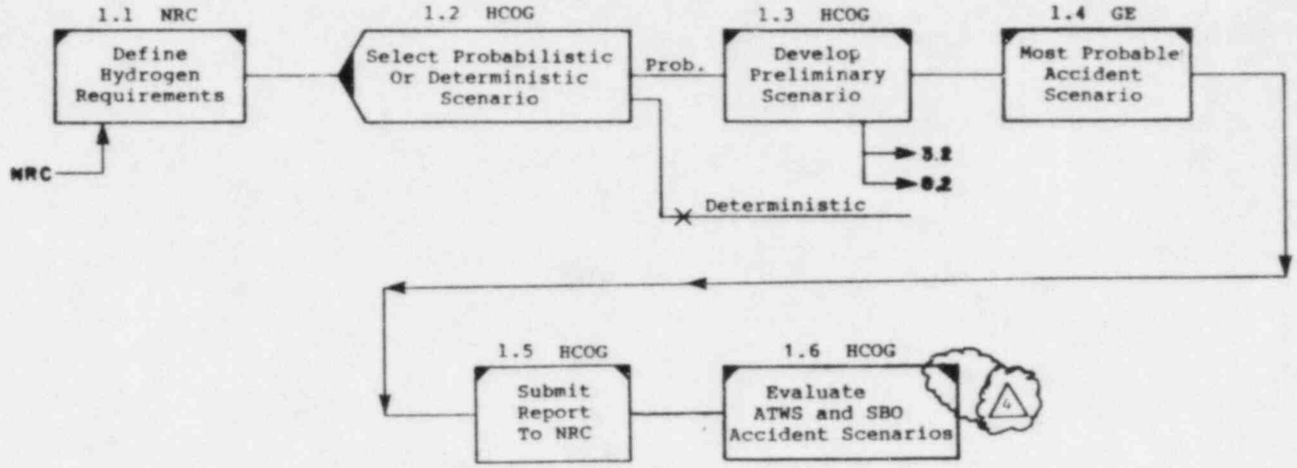
2. Nuclear plant equipment used in the Nevada Test Site (NTS) tests will be reviewed and equipment and cables which are similar in manufacture and design to equipment utilized by HCOG member utilities shall be identified. Equipment and cables not applicable to HCOG member utilities shall also be identified.

3. Equipment and components used in the NTS test series and similar to equipment and components used by HCOG member utilities shall be evaluated to determine all failures which
occurred in the tests. The cause of failure and, if available,]4
the manufacturer's evaluation of the failure, shall be identified.

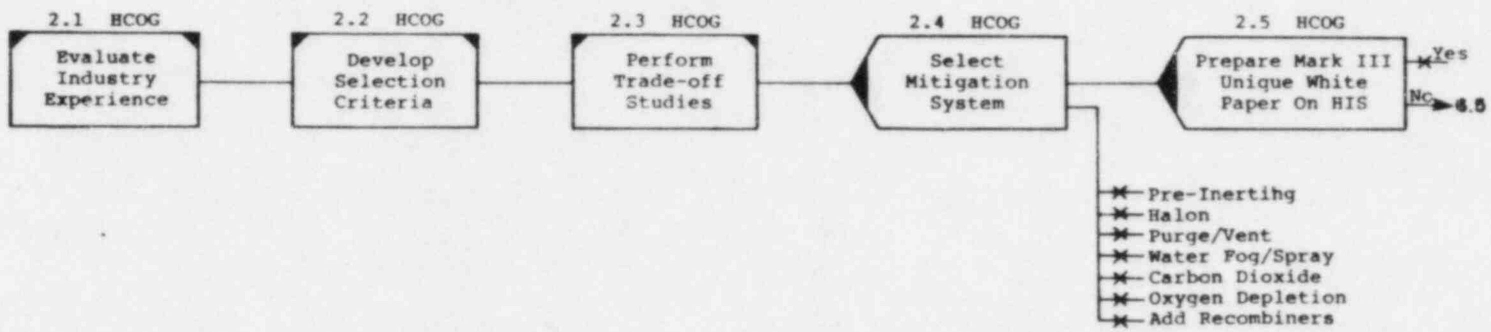
4. Premixed combustion tests from NTS shall be evaluated for]4
equipment performance and thermal response. The only tests]4
which shall be evaluated are those tests which produce thermal]4
environments which are comparable to thermal environments]4
produced in Mark III containments.]4

5. Data from premixed and continuous hydrogen injection tests shall be reviewed to provide a comparison between assumptions

1.0 ESTABLISH MOST PROBABLE HYDROGEN GENERATION EVENT

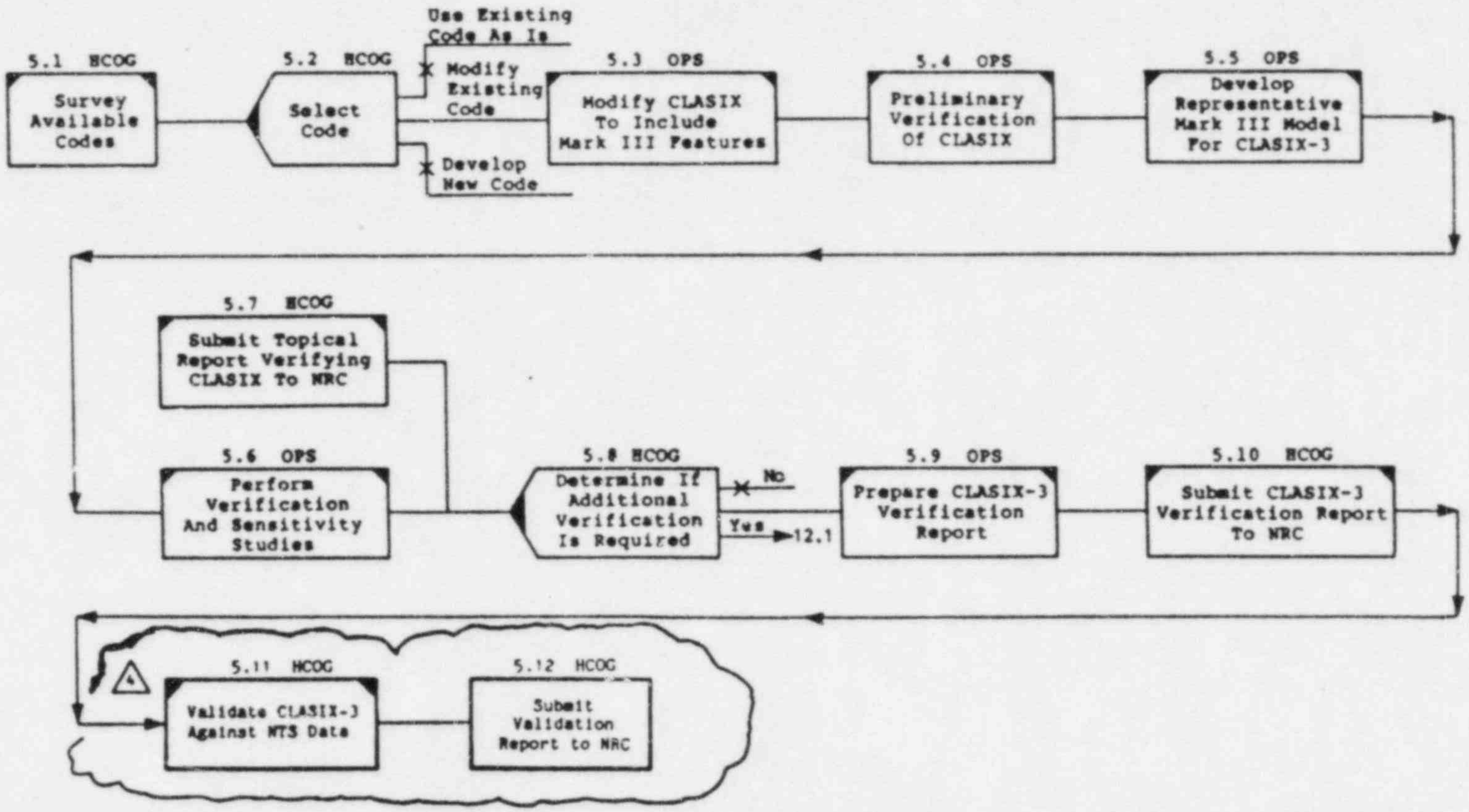


2.0 SELECT MITIGATION SYSTEM



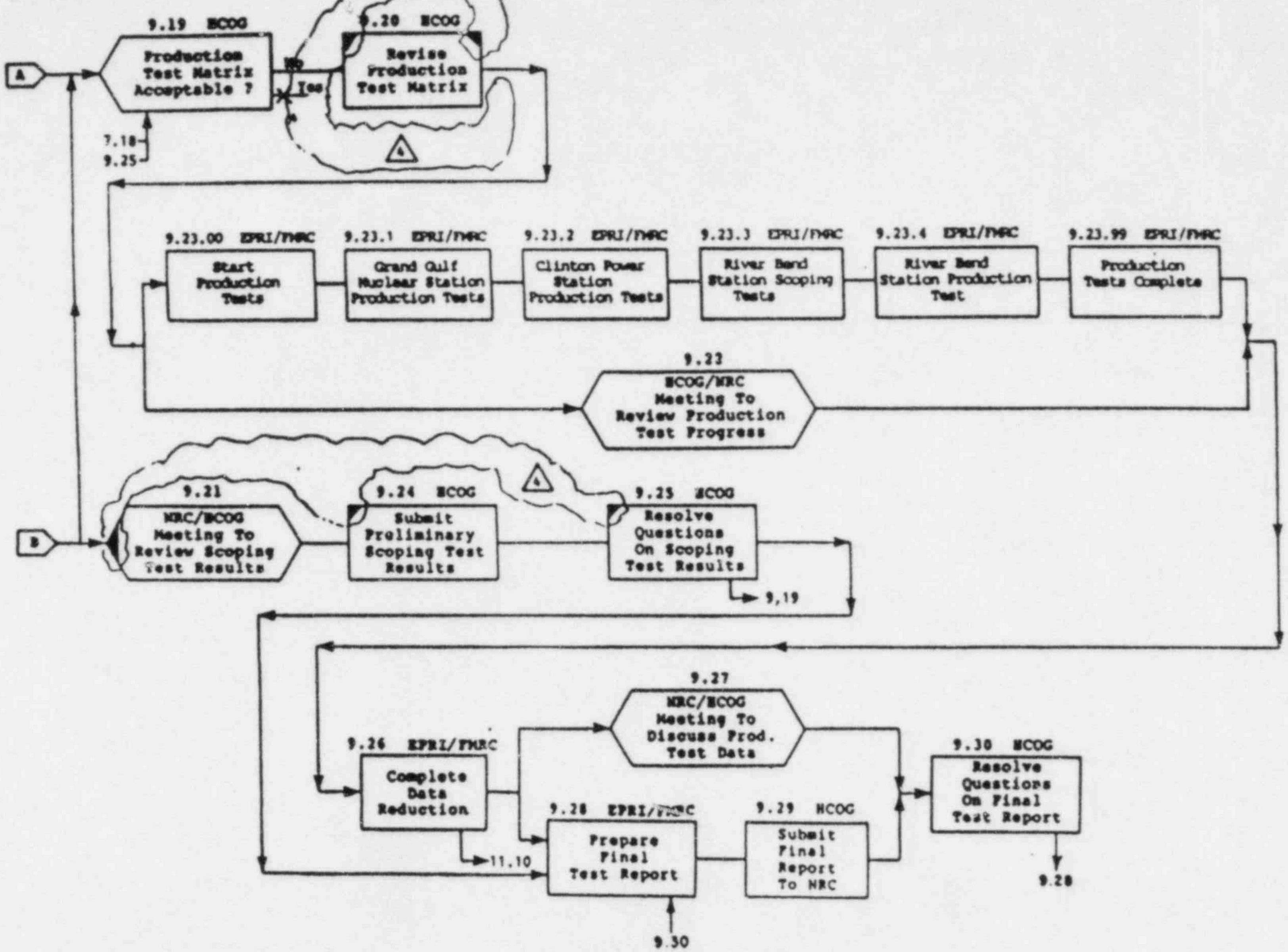
10/29/85

5.0 SELECTION OF CONTAINMENT RESPONSE ANALYSIS CODE



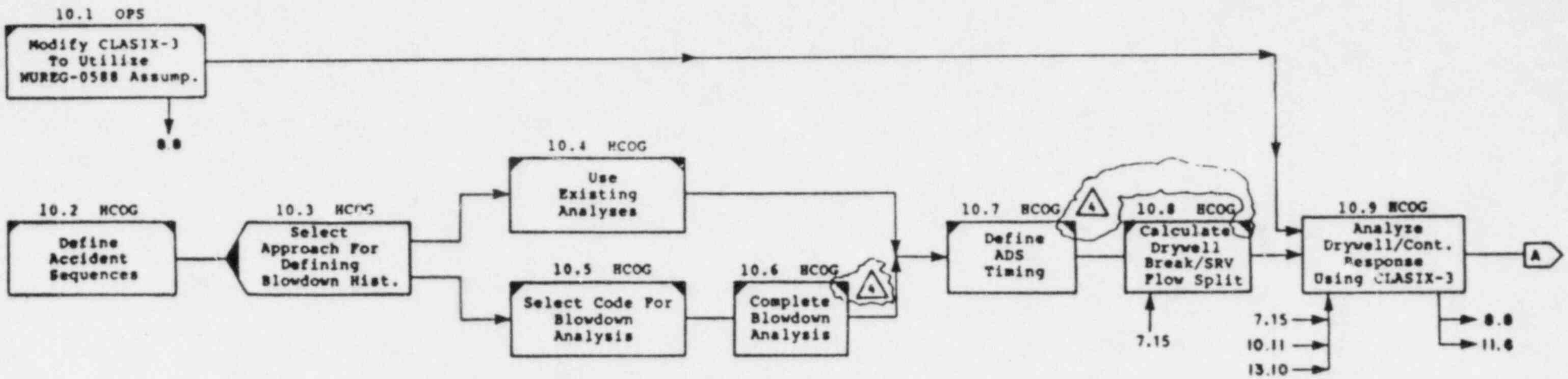
10/29/85

9.0 DIFFUSION FLAME THERMAL ENVIRONMENT
(1/4 SCALE TEST PROGRAM)
(CONT)

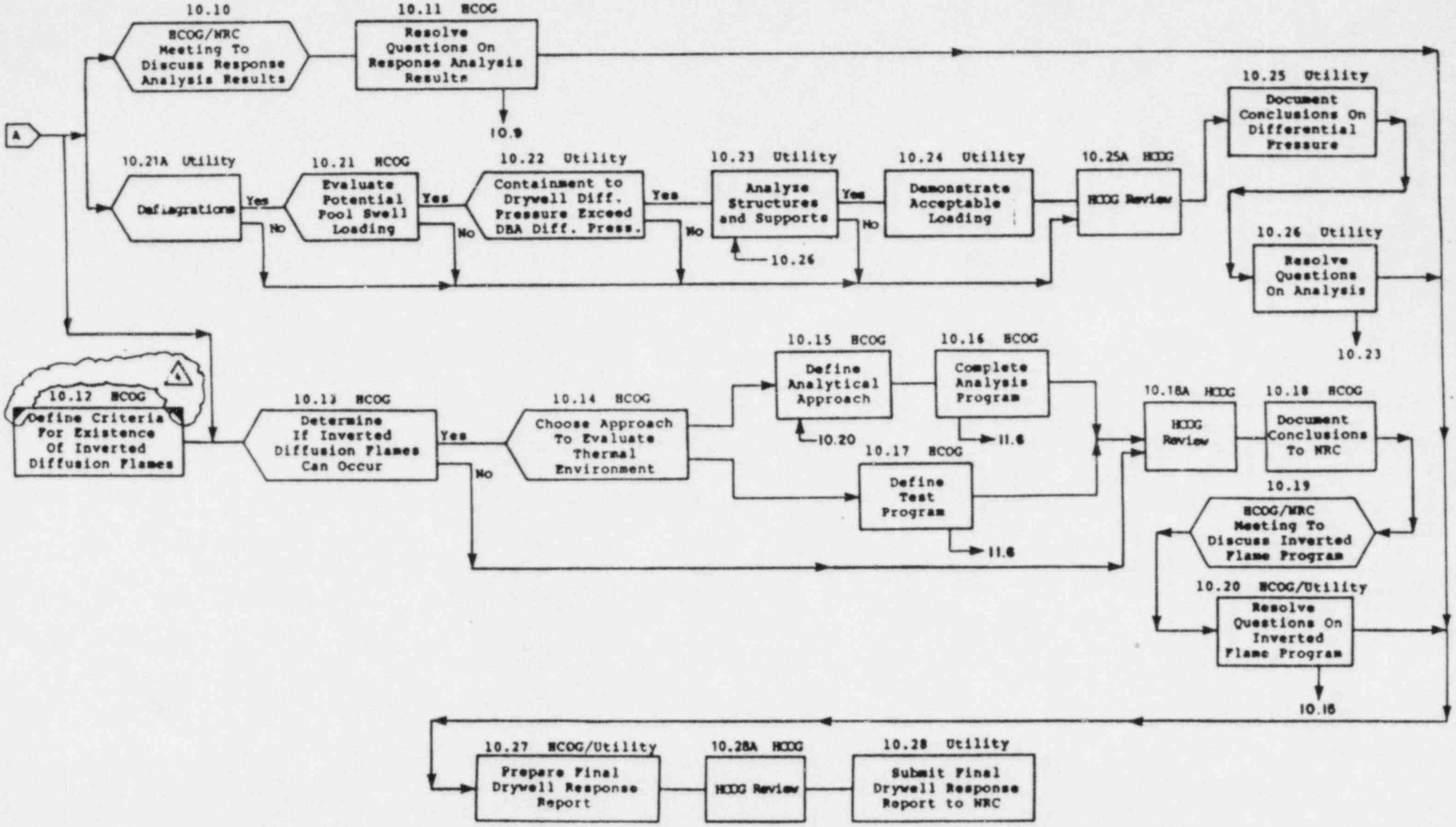


10/29/85

10.0 EVALUATION OF DRYWELL RESPONSE TO DEGRADED CORE ACCIDENTS

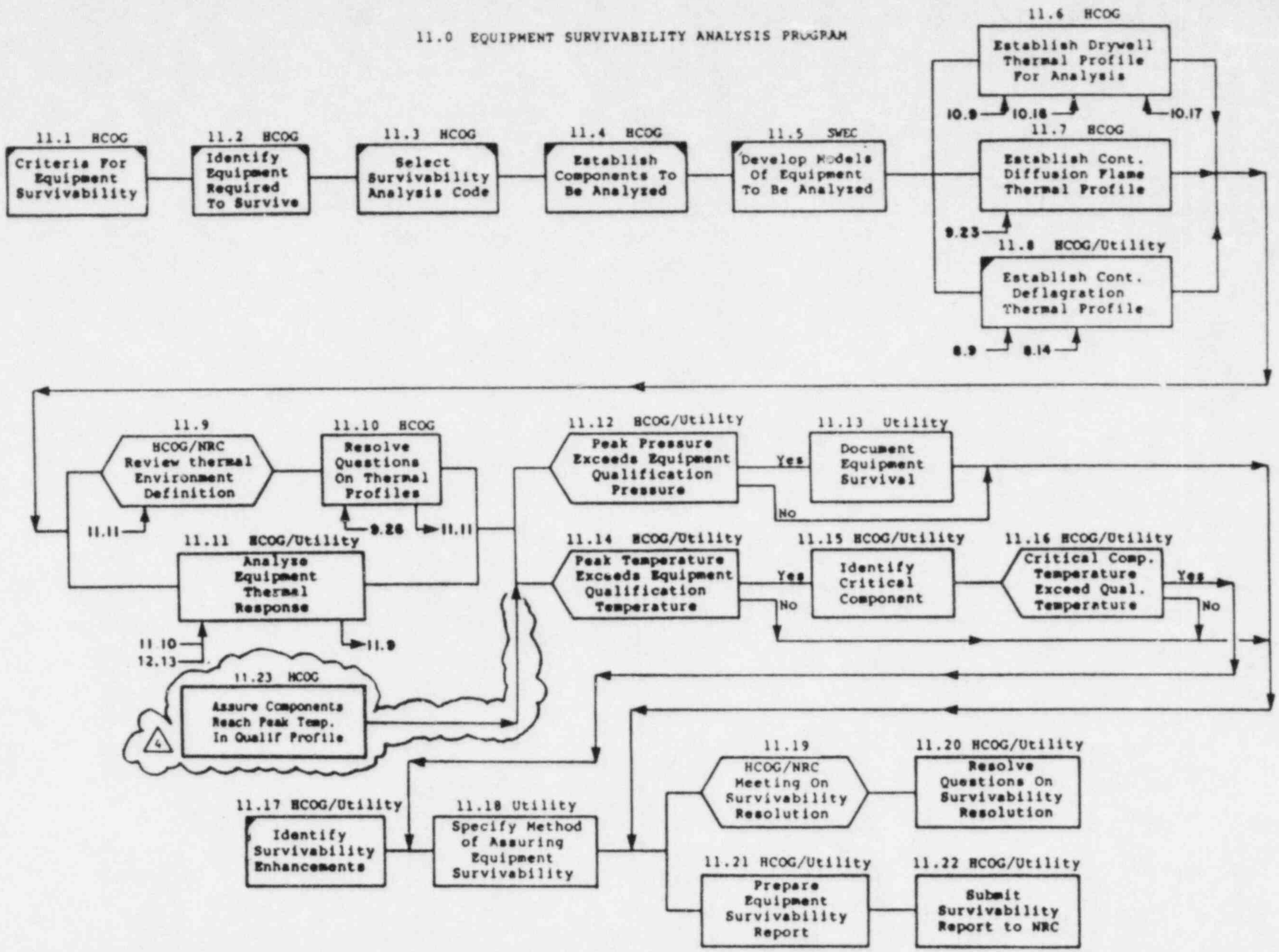


10.0 EVALUATION OF DRYWELL RESPONSE TO DEGRADED CORE ACCIDENTS (CONT)



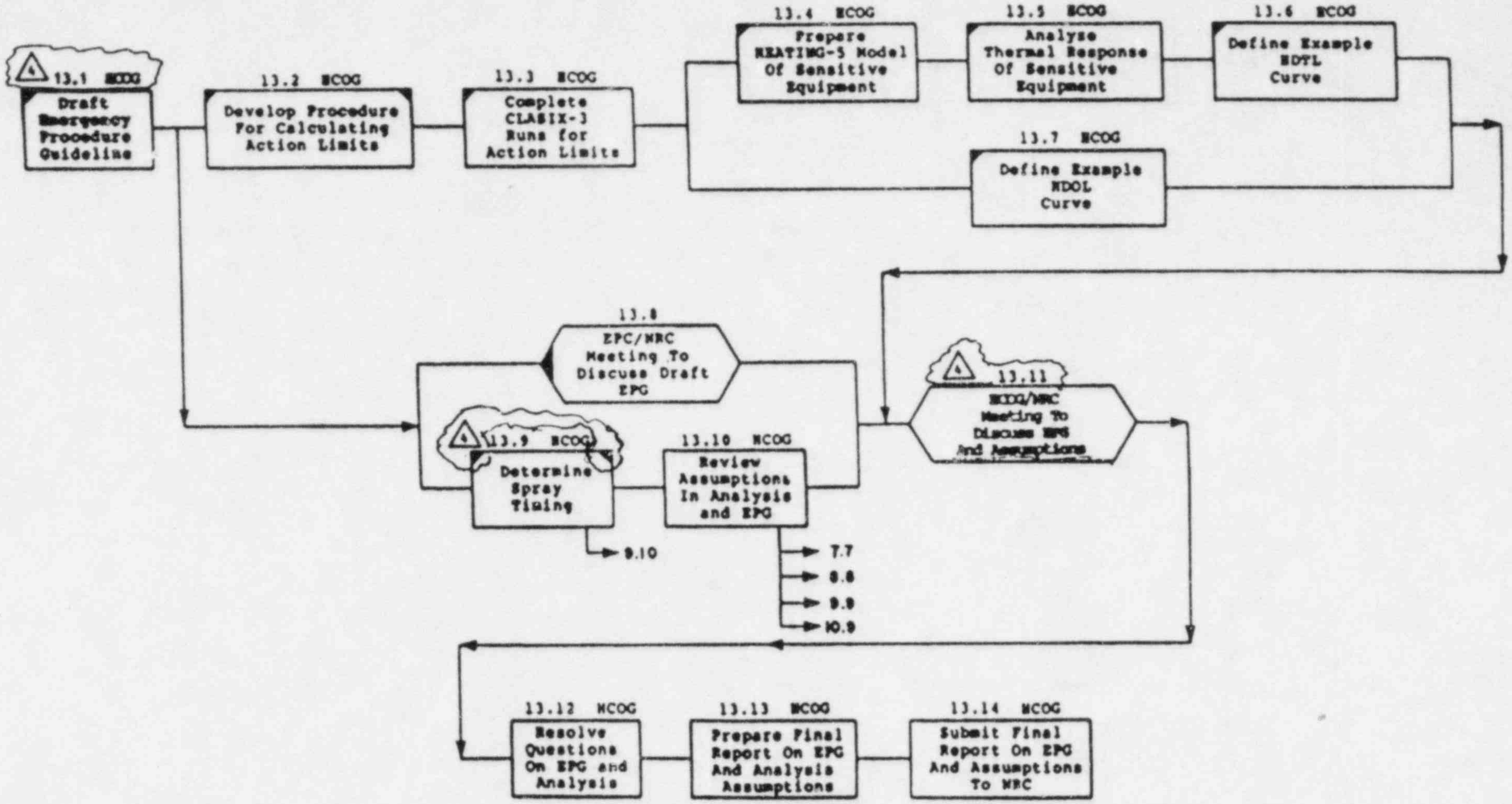
10/29/85

11.0 EQUIPMENT SURVIVABILITY ANALYSIS PROGRAM



10/29/85

13.0 COMBUSTIBILE GAS CONTROL EPG



10/29/85

MILESTONE SCHEDULE

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NCOG MILESTONES   1985           1986                                                       1987
----------------- OCT  NOV  DEC  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  JAN
      NAME        0    1    2    3    4    5    6    7    8    9    10   11   12   13   14   15

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9.18,9.24         O=============).    .    .    .    .    .    .    .    .    .    .    .    .
TO NRC            .    .    .    *    .    .    .    .    .    .    .    .    .    .    .    .
9.25              .    .    .    )========I.    .    .    .    .    .    .    .    .    .    .
9.23              O=======================).    .    .    .    .    .    .    .    .    .    .
9.22 NRC MTG      .    .    .    .    .    I    .    .    .    .    .    .    .    .    .    .
9.26              .    S=======================).    .    .    .    .    .    .    .    .    .
9.27 NRC MTG      .    .    .    .    .    .    I    .    .    .    .    .    .    .    .    .
9.28              .    .    .    .    .    .    S==================).    .    .    .    .    .
9.29 TO NRC       .    .    .    .    .    .    .    .    .    .    *    .    .    .    .    .
9.30              .    .    .    .    .    .    .    .    .    .    )========I.    .    .    .
9.31              O========I.    .    .    .    .    .    .    .    .    .    .    .    .    .
10.9              O=============).    .    .    .    .    .    .    .    .    .    .    .    .
10.10 NRC MTG     .    .    .    I    .    .    .    .    .    .    .    .    .    .    .    .
10.11-10.17       .    S==================).    .    .    .    .    .    .    .    .    .    .
10.18 TO NRC      .    .    .    .    .    *    .    .    .    .    .    .    .    .    .    .
10.19 NRC MTG     .    .    .    .    .    *    .    .    .    .    .    .    .    .    .    .
10.20             .    .    .    .    .    )========I.    .    .    .    .    .    .    .    .
10.21-10.24       .    S=======================).    .    .    .    .    .    .    .    .    .
10.25 TO NRC      .    .    .    .    .    I    .    .    .    .    .    .    .    .    .    .
10.26-10.27       .    .    .    S============================).    .    .    .    .    .    .
10.28 TO NRC      .    .    .    .    .    .    .    .    .    I    .    .    .    .    .    .
11.4-11.21        O=========================================================================).
11.22 TO NRC      .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    I
11.23             .    .    .    .    .    .    S========I.    .    .    .    .    .    .    .
12.1-12.10        O=======================).    .    .    .    .    .    .    .    .    .    .
12.11 NRC MTG     .    .    .    .    .    *    .    .    .    .    .    .    .    .    .    .
12.12             .    .    .    .    .    )========I.    .    .    .    .    .    .    .    .
12.13             .    .    .    .    .    .    .    .    S========).    .    .    .    .    .
12.14 TO NRC      .    .    .    .    .    .    .    .    .    .    I    .    .    .    .    .
13.1-13.13        O============================).    .    .    .    .    .    .    .    .    .
13.11 NRC MTG     .    .    .    I    .    .    .    .    .    .    .    .    .    .    .    .
13.14 TO NRC      .    .    .    .    .    .    I    .    .    .    .    .    .    .    .    .
14.2-14.5         O===).    .    .    .    .    .    .    .    .    .    .    .    .    .    .
14.6              .    *    .    .    .    .    .    .    .    .    .    .    .    .    .    .
14.7 NRC MTG      .    *    .    .    .    .    .    .    .    .    .    .    .    .    .    .
14.8-14.9         .    )=============).    .    .    .    .    .    .    .    .    .    .    .
14.10 TO NRC      .    .    .    .    I    .    .    .    .    .    .    .    .    .    .    .
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10/29/85