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March 20, 1984

80-04 #11

Mr J G Keppler, Regional Administrator
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MIDLAND ENERGY CENTER PROJECT
DOCKET NOS 50-329 AND 50-330
HELBA RESTRAINT DESIGN
FILE: 0.4.9.41 SERIAL: 28053

References: J W Cook letter to J G Keppler, Same Subject:

- (1) Serial 8830, dated September 19, 1980
- (2) Serial 10070, dated December 1, 1980
- (3) Serial 11525, dated April 3, 1981
- (4) Serial 13663, dated September 4, 1981
- (5) Serial 14634, dated December 14, 1981
- (6) Serial 16147, dated March 31, 1982
- (7) Serial 19039, dated September 15, 1982
- (8) Serial 20686, dated January 30, 1983
- (9) Serial 22184, dated May 6, 1983
- (10) Serial 28010, dated February 20, 1984

This letter, as were the referenced letters, is an interim 10CFR50.55(e) report concerning HELBA restraint design. Attachment 1 provides a status of the actions being taken with regard to this matter. Please note that Attachment 1 is a revision to the report attached to our February 20, 1984 letter. This revision has clarified the Probable Cause portion of the report.

Another report, either interim or final, will be sent on or before September 28, 1984.

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PDR ADOCK 05000329
S PDR

JWC/AHB/lr

Attachment 1: MCAR 40, Interim Report 10, Revision 1, dated 3/16/84

OC0384-0024A-MP01

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MAR 28 1984

CC: Document Control Desk, NRC
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3/14/84

Bechtel Associates Professional Corporation

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SUBJECT: MCAR 40 (issued 8/26/80)

High-Energy Line Break Analysis (HELBA)
Pipe Whip Restraint Designs

INTERIM REPORT: 10, Revision 1

DATE: March 16, 1984

PROJECT: Consumers Power Company
Midland Plant Units 1 and 2
Bechtel Job 7220

Introduction

This report provides the current status of MCAR 40 and actions performed since Interim Report 10.

Description of Deficiency

FSAR Subsection 3.6.2.2 states that the analysis of the thrust forces that result in the event of a pipe rupture is described in BN-TOP-2. The steady-state thrust forces rather than transient peak thrust forces were used in the energy balance techniques for the design of HELBA pipe whip restraints. This technique might result in some nonconservative restraint designs.

Summary of Investigation

All blowdown thrust force time histories were determined using the computer program PRTHRUST and comparable hand calculations. The restraint designs were evaluated with the PIPERUP computer program as discussed in the Corrective Action section below.

Analysis of Safety Implication

The safety-related function of a pipe whip restraint is to limit pipe movement following a high-energy line break to prevent unacceptable damage to essential systems or components. Designing the restraint using the steady-state thrust force instead of the higher transient thrust force could compromise this safety function. The size of the restraints may be inadequate for the increased loads, and/or their location may be inadequate because a higher thrust force may cause the plastic hinge length to decrease outside the range of the restraint. This deficiency, had it remained uncorrected, may have adversely affected the safety of operations at the Midland plant if certain types of accidents were to occur.

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Probable Cause

The cause of this discrepancy is that the analysis of postulated instantaneous pipe rupture used a conclusion that steady-state thrust forces were an upper limit; however, this did not in all cases envelope the results that would be obtained by unique thrust force time history analysis.

BN-TOP-2 provides a method of generating steady-state thrust forces accounting for frictional effects, and states that designing to the steady-state force is not always a conservative assumption unless justified, based on a time history analysis. Analysts deduced that the steady-state thrust force bounded any transient loads by performing comparative analyses on a number of sample problems. Several cases were analyzed, and it was concluded (incorrectly) that the restraint design using the steady-state force always enveloped the results of unique thrust force time histories.

Subsequent review in 1980 identified several situations for which this conclusion was not valid.

Corrective Action

The status of corrective action is as follows.

Initially, 325 restraints were considered to be associated with the MCAR 40 concern. The number of potentially affected restraints was reduced to 116 by deletions due to pipe rerouting, shifts in break locations, and changes in analysis assumptions.

The attached table shows the status of the remaining 116 restraints, many of which are being modified for reasons other than the subject problem. However, a detailed evaluation of each restraint is not being made to determine if the redesign is necessary for MCAR 40 concerns or for other reasons.

Since the last interim report, Consumers Power Company has indefinitely deferred design and construction of Unit 1 and the evaporator steam supply steam. Pipe whip restraints in the attached table that are affected by this deferral are indicated by Footnote 4 in the Construction Hold column.

In addition, Consumers Power Company has directed that pipe whip restraints designed to mitigate arbitrary intermediate location pipe breaks be placed on hold. The pipe whip restraints in the attached table affected by this hold are indicated by Footnote 3 in the Construction Hold column. This hold has been placed in anticipation that the requirement to postulate arbitrary intermediate breaks (and to design mitigative devices for these breaks) will be removed.

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All MCAR 40 concerns, including plastic hinge lengths, have already been incorporated into the design process. The peak pressure blowdown forces have been calculated and provided as input for the design of pipe whip restraints. The whip restraints have been designed or are being designed to appropriate criteria, which include peak pressure blowdown forces.

Assumptions and work processes used by the HELBA group were reviewed by the Bechtel chief nuclear engineer for problems similar to the MCAR 40 concern. No other areas were identified as having similar potential problems. Part of the corrective action has included training sessions for the nuclear HELBA group to preclude recurrence of problems similar to MCAR 40.

Final design drawings will be issued as required when the final decision is made regarding the requirement to postulate arbitrary intermediate breaks.

Reportability

This condition was reported by Consumers Power Company to the NRC as a potential 10 CFR 50.55(e) reportable condition on August 21, 1980.

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RJB
RJB/JEG/dao*(N)

Attachment: Status of Pipe Whip Restraints Potentially Affected by
MCAR 40, January 31, 1984

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MIDLAND UNITS 1 AND 2

STATUS OF PIPE WHIP RESTRAINTS POTENTIALLY AFFECTED BY MCAR 40(1)

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System ID	Pipe ⁽²⁾ Restraint	Bldg	Restr Install (%)	Constr Hold	Size OK Phase I	Loc OK Phase I	Size OK Phase II	Loc OK Phase II	Mod. Needed Size	Mod. Needed Loc
Inside Containment										
DH return line	PR-610-2-6	Reactor	50	Yes ⁽⁴⁾	No	No	No	No	Yes	Yes
DH return line	PR-610-2-8	Reactor	50	Yes ⁽⁴⁾	No	No	Yes	Yes	No	No
DH return line	PR-610-2-10	Reactor	50	Yes ⁽⁴⁾	No	No	No	No	Yes	Yes
DH return line	PR-610-2-12	Reactor	50	Yes ⁽⁴⁾	No	No	No	No	Yes	Yes
DH return line	PR-611-2-3	Reactor	100	No	No	No	No	No	Yes	Yes
DH return line	PR-611-2-5	Reactor	100	Yes ⁽³⁾	No	No	No	No	Yes	Yes
DH return line	PR-611-2-9	Reactor	100	No	No	No	Yes	Yes	No	No
DH return line	PR-611-2-12	Reactor	0	No	No	No	No	No	Yes	Yes
DH return line	PR-611-2-13	Reactor	0	No	No	No	No	No	Yes	Yes
DH return line	PR-611-2-21	Reactor	100	No	No	No	No	Yes	Yes	No
MFW	PR-638-13-5	Reactor	0	Yes ⁽⁴⁾	No	No	Yes	Yes	No	No
MFW	PR-638-13-6	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-7	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-8	Reactor	0	Yes ⁽⁴⁾	No	No	No	Yes	Yes	No
MFW	PR-638-13-9	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-14	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-15	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-16	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-17	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-18	Reactor	0	Yes ⁽⁴⁾	No	No	No	Yes	Yes	No
MFW	PR-638-13-19	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-20	Reactor	0	Yes ⁽⁴⁾	No	Yes	No	-	Yes	No
MFW	PR-638-13-21	Reactor	0	Yes ⁽⁴⁾	No	No	No	No	Yes	Yes
MFW	PR-639-13-2	Reactor	100	No	No	No	No	Yes	Yes	No
MFW	PR-639-13-16	Reactor	50	No	No	Yes	No	-	Yes	No
MFW	PR-639-13-17	Reactor	50	No	No	No	No	Yes	Yes	No
MFW	PR-639-13-18	Reactor	30	No	No	No	No	Yes	Yes	No
MFW	PR-639-13-29	Reactor	50	No	No	Yes	No	-	Yes	No
MFW	PR-639-13-35	Reactor	100 ⁽⁵⁾	No	Yes	Yes	-	-	No	No
HPI, Normal MU	PR-604-1-15	Reactor	0	Yes ⁽⁴⁾	Yes	No	-	No	No	Yes
HPI, Normal MU	PR-604-2-41	Reactor	0	Yes ⁽⁴⁾	Yes	No	-	No	No	Yes
Letdown	PR-603-3-2	Reactor	0	Yes ⁽⁴⁾	No	No	No	No	Yes	Yes
Letdown	PR-603-3-4	Reactor	0	Yes ⁽⁴⁾	No	No	No	Yes	Yes	No
Letdown	PR-603-3-6	Reactor	100	Yes ⁽⁴⁾	No	No	No	Yes	Yes	No
Letdown	PR-603-3-8	Reactor	100	Yes ⁽⁴⁾	-	No	No	Yes	Yes	No

Pipe Whip Restraints Potentially Affected by MCAR 40 (continued)

System ID	Pipe(2) Restraint	Bldg	Restr Install (%)	Constr Hold	Size OK Phase I	Loc OK Phase I	Size OK Phase II	Loc OK Phase II	Mod. Needed Size	Mod. Needed Loc
Letdown	PR-603-3-9	Reactor	100	Yes(4)	-	No	No	Yes	Yes	No
Letdown	PR-603-3-10	Reactor	0	Yes(4)	-	No	No	Yes	Yes	No
Letdown	PR-604-3-7	Reactor	0	No	No	No	No	No	Yes	Yes
Letdown	PR-604-3-9	Reactor	100	No	No	No	No	No	Yes	Yes
Letdown	PR-604-3-10	Reactor	0	No	-	No	No	No	Yes	Yes
Letdown	PR-604-3-48	Reactor	0	Yes(3)	No	No	No	No	Yes	Yes
Outside Containment										
APW	PR-633-4-4	Aux	0	Yes(4)	No	No	No	Yes	Yes	No
APW	PR-633-5-1	Aux	0	Yes(4)	No	No	No	Yes	Yes	No
APW	PR-633-5-2A	Aux	0	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-3	Aux	0	Yes(4)	No	No	Yes	Yes	No	No
APW	PR-633-5-5	Aux	0	Yes(4)	No	No	No	Yes	Yes	No
APW	PR-633-5-6A	Aux	100	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-6B	Aux	100	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-7	Aux	0	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-9	Aux	0	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-12	Aux	0	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-633-5-18	Aux	0	Yes(4)	No	No	No	No	Yes	Yes
APW	PR-634-5-1	Aux	0	No	No	No	No	No	Yes	Yes
APW	PR-634-5-2	Aux	0	No	No	No	No	No	Yes	Yes
APW	PR-634-5-3	Aux	0	No	No	No	No	Yes	Yes	No
APW	PR-634-5-4B	Aux	0	No	No	No	No	Yes	Yes	No
APW	PR-634-5-10	Aux	100	No	No	No	No	No	Yes	Yes
APW	PR-634-6-2A	Aux	100	Yes(3)	No	No	No	No	Yes	Yes
APW	PR-634-6-3	Aux	0	Yes(3)	No	No	Yes	Yes	No	No
APW	PR-634-6-4	Aux	100	Yes(3)	No	No	No	No	Yes	Yes
APW	PR-634-6-7	Aux	100	No	No	No	No	No	Yes	Yes
APW	PR-634-6-8	Aux	100	No	No	No	No	No	Yes	Yes
Main steam	PR-631-2-1	Aux	100	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-2-2	Aux	100	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-2-3	Aux	100	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-2-4	Turbine	40	Yes(4)	-	-	No	Yes	Yes	No
Main steam	PR-631-2-5	Turbine	40	Yes(4)	-	-	No	Yes	Yes	No
Main steam	PR-631-2-6	Turbine	40	Yes(4)	-	-	No	Yes	Yes	No
Main steam	PR-631-3-1	Aux	95	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-3-2	Aux	95	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-3-3	Aux	95	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-631-3-4	Turbine	0	Yes(4)	-	-	No	Yes	Yes	No

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Pipe Whip Restraints Potentially Affected by MCAR 40 (continued)

System ID	Pipe(2) Restraint	Bldg	Restr Install (%)	Constr Hold	Size OK Phase I	Loc OK Phase I	Size OK Phase II	Loc OK Phase II	Mod. Needed Size	Mod. Needed Loc
Main steam	PR-631-3-5	Turbine	0	Yes(4)	-	-	No	Yes	Yes	No
Main steam	PR-631-3-6	Turbine	0	Yes(4)	-	-	No	Yes	Yes	No
Main steam	PR-632-2-1	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-2	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-3	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-4	Turbine	40	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-5	Turbine	40	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-6	Turbine	40	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-7	Turbine	40	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-8	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-2-9	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-1	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-2	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-3	Aux	95	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-4	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-5	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-6	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-7	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-8	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-9	Turbine	0	No	-	-	Yes	Yes	No	No
Main steam	PR-632-3-10	Aux	90	No	Yes	Yes	-	-	No	No
Main steam	PR-660-1-1	Aux	90	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-2	Aux	90	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-3	Aux	90	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-660-1-4	Aux	90	Yes(4)	-	-	Yes	Yes	No	No
Main steam	PR-660-1-5	Tunnels	0(5)	No	No	No	No	No	Yes	Yes
Main steam	PR-660-1-6	Tunnels	0	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-7	Tunnels	0	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-8	Tunnels	0(5)	No	No	No	No	No	Yes	Yes
Main steam	PR-660-1-9	Tunnels	0	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-10	Tunnels	0	Yes(4)	No	No	No	No	Yes	Yes
Main steam	PR-660-1-11	Tunnels	0	Yes(4)	No	No	No	No	Yes	Yes
Main steam	PR-660-1-12	Tunnels	0	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-13	Aux	95	Yes(4)	No	Yes	No	-	Yes	No
Main steam	PR-660-1-14	Tunnels	0	Yes(4)	No	No	No	No	Yes	Yes
Main steam	PR-660-1-15	Tunnels	0(5)	No	No	No	No	No	Yes	Yes
Letdown	PR-603-15-1	Aux	0(5)	No	No	No	-	-	Yes	Yes
Letdown	PR-603-15-4	Aux	0	Yes(4)	No	No	-	-	Yes	Yes
Letdown	PR-603-15-5	Aux	0(5)	No	No	No	-	-	Yes	Yes
Letdown	PR-604-15-1	Aux	0(5)	No	No	No	-	-	Yes	Yes
Letdown	PR-604-15-2	Aux	0(5)	No	No	No	-	-	Yes	Yes

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Pipe Whip Restraints Potentially Affected by MCAR 40 (continued)

System ID	Pipe(2) Restraint	Bldg	Restr Install (%)	Constr Hold	Size OK Phase I	Loc OK Phase I	Size OK Phase II	Loc OK Phase II	Mod. Needed Size	Mod. Needed Loc
Letdown	PR-604-15-3	Aux	0(5)	No	No	No	-	-	Yes	Yes
Letdown	PR-604-15-5	Aux	0(5)	No	No	No	-	-	Yes	Yes
Letdown	PR-604-15-7	Aux	0(5)	No	No	No	-	-	Yes	Yes

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Footnotes

- (1)Phase I is an energy balance analysis; Phase II is a time-history (dynamic) analysis
- (2)Total potentially affected pipe whip restraints = 116
- (3)This pipe whip restraint is designed to mitigate a postulated arbitrary-location intermediate break and has been placed on hold in accordance with Consumers Power Company direction via letter to Bechtel dated November 18, 1983 (Com 135279).
- (4)This pipe whip restraint is associated with Unit 1 or the evaporator steam supply system. Those systems have been indefinitely deferred by Consumers Power Company.
- (5)This pipe whip restraint is being deleted.

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LEGEND:

DH: Decay heat
MFW: Main feedwater
APW: Auxiliary feedwater
HPI: High-pressure injection
MU: Makeup
AUX: Auxiliary
NA: Not available
Loc: Location
Mod: Modification