

**Reportable Event Report on the Maanshan Nuclear Power Plant Unit 2  
September 8 Main Steam Line Low Pressure Incident that Triggered  
the Actuation of the Main Steam Isolation and Feed Water Isolation,  
and the Reactor Trip Signals**

**(RER-94-32-003)**

1. Description of Event

An inspection and repair procedures were conducted on breakdown GIB ( Gas Insulated Bus ) at the Maanshan Nuclear Power Plant Unit 2 on September 8, 2005. The unit was maintained at hot standby mode and RCP B in running condition. The three Main Steam Isolation Valves (MSIVs) and three Feed Water Isolation Valves (FWIVs) were shut and isolated. In order to establish the initial conditions (where three RCPs should be running) of the Pressurizer spray bypass valve flow setting test, the operating personnel started the RCP A at 11:57; then at 12:00, the personnel started the RCP C. A primary side temperature rise could cause a corresponding slow rise in the steam generator pressure; however, since the main steam line C contained accumulated water from condensation, it created a two-phase flow disturbance that caused pressure transient (oscillation). At 12:37, the secondary side pressure of steam generator C had dropped to the set point; thus it actuated the Main Steam Isolation Signal (MSIS), the Feed Water Isolation Signal (FWIS), and the reactor trip signal. The reportable event was classified as a level 0 event bearing no safety significance on the International Nuclear Event Scale (INES).

2. Cause of Event

It was deduced that the cause triggering this safety system actuation and the generation of the reactor trip signal was originated from the destruction of the condenser vacuum and isolation of boundary, in order that personnel of the Maanshan Nuclear Power Plant could conduct repair work on the secondary side peripheral equipment on September 2. Because of leakage on the MSIVs, the personnel opened the MSIV downstream drain valves to release steam to the atmosphere; moreover, the personnel also shut the main steam line drain isolation valves AB-HV107/ HV207/HV307 (see attached illustration) to keep

steam release away from the condenser. This measure caused water accumulation in the steam lines, and in the subsequent transient stage, it triggered a water hammering problem, thus causing pressure transient that resulted in the low pressure condition of steam line C. However, further investigation and understanding is required to determine the true root cause of this problem.

### 3. Root Cause of Event and Corrective Measures

#### (1) Root Cause of Event

This reportable event was due to the accumulation of water in the main steam lines after the drain isolation valves AB-HV107/ HV207/HV307 were shut. In the subsequent transient stage, it triggered a water hammer, an effect that has been verified as a clear cause of the problem. However, after the occurrence of the reportable event, it was found that many main steam line safety valves were activated at the time of event. Furthermore, a drift was noted in the trip setpoints of two safety valves. It is imperative to understand the correlation of this drift to the reportable event.

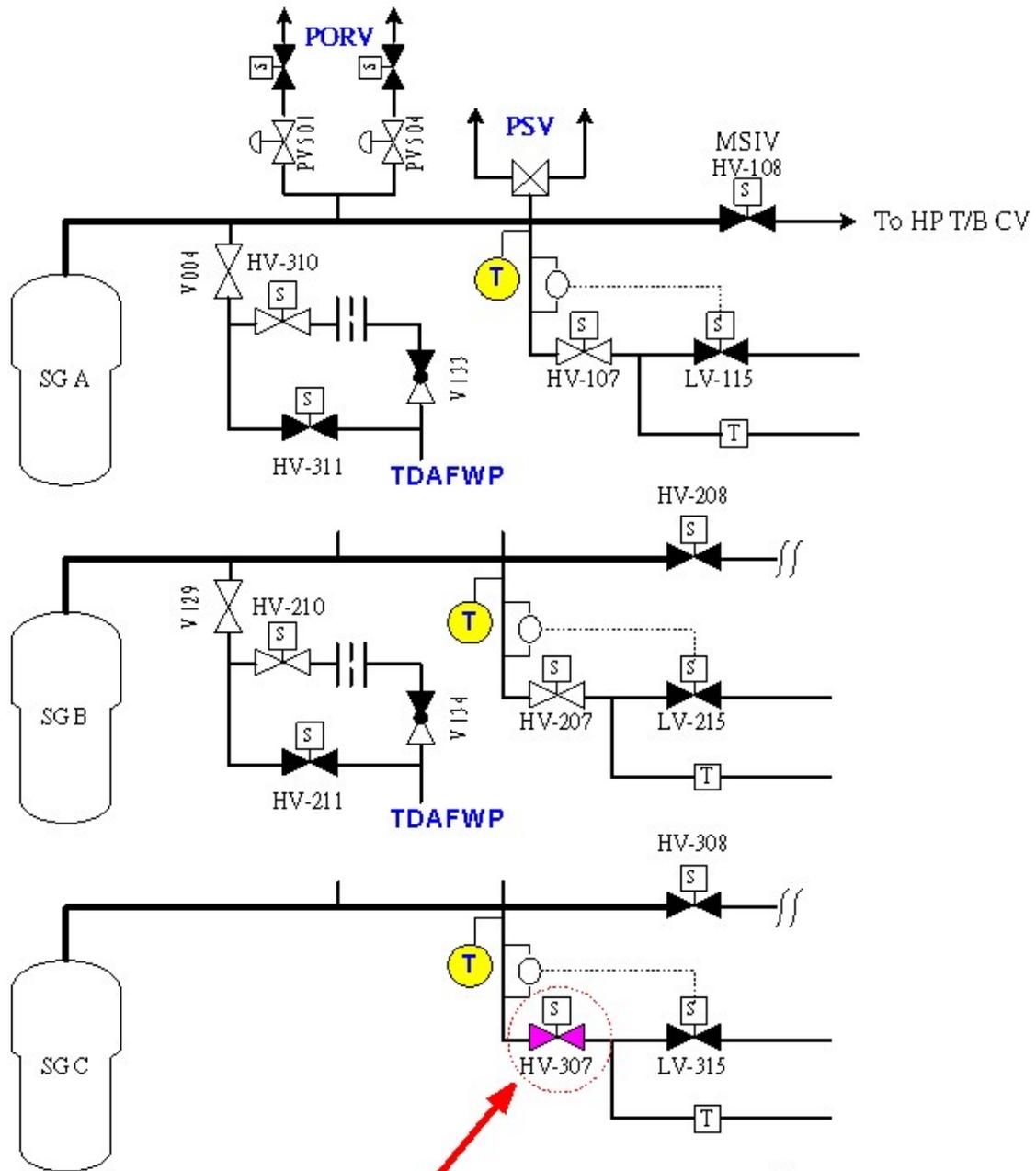
#### (2) Corrective Measures

Maanshan Nuclear Power Plant instituted the following corrective measures after the actuation of the safety system: (1) Rechecked to ensure that all the bonnet bolt nuts and adjusting bolt nuts of the main steam safety valves (15 valves) are not loose; (2) Perform a Magnetic particle Test (MT) on the springs of safety valve AB-PSV302, 303, 304, and 306 to verify whether springs contained cracks or breakages; (3) Ran a main steam line C pipeline support and framework integrity test; test results reported normal status; (4) In the future, MSIV leakage condition should be verified during the outage inspection period of the unit; improvement measures instituted should be determined by the requirement of circumstances; (5) Amend the GOP procedures 202, 203, 204, 210, 211, 212, and 216: drain isolation valves AB-HV107, HV207, HV307 of the main steam lines should be kept open to prevent condensation related water accumulation in the steam pipes. In cases wherein the secondary side is under inspection and thus the water in the drain pipeline could not be drained to the condenser, the drainage

pipeline should be rerouted out of the turbine building, thus keeping the drain pipelines of the main steam lines unobstructed; and (6) Include the reportable event into the training course program of duty personnel (including the classroom and simulator training courses).

#### 4. AEC Regulatory Measures

Taiwan Power Company called to report the safety system actuation of Maanshan Nuclear Power Plant Unit 2 to the AEC on September 8, to enable AEC to investigate status of unit. In the first moment, AEC verified that unit was in safe shutdown status, and that the safety systems were operated according to the design functions. On September 9, Taiwan Power Co. came to AEC to present an analysis report of unit trip incidents. The AEC demanded an explanation of this reportable event due to some questionable matters requiring clarification. AEC has included the investigation of the root cause of this reportable event into the list of items for follow-up check.



- Main steam lines A and B continue to supply heating steam to the turbine-driven auxiliary feedwater pump. The loop C design does not contain this design function.
- If the unit is kept in warm standby condition for a long period, and the drain valve is isolated, as a result of which, water may be accumulated in the pipes.

Diagram: Location of Drain Valves in the Steam Line