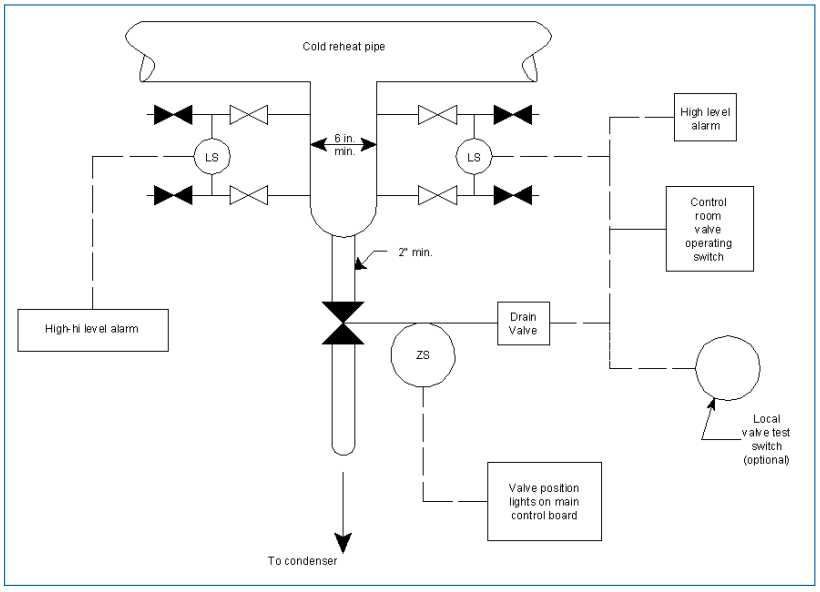
Turbine Water Induction Protection (TWIP)

Turbine Water Induction Protection, often abbreviated as TWIP, is the broad category of equipment that is installed to prevent water damage to steam turbines. Any connection to the turbine is a potential source of water either by induction from external equipment or by accumulation of condensed steam. Steam turbine damage by water induction is a costly economic, safety and reliability concern. The American Society of Mechanical Engineers (ASME) formed a committee to address this issue, and the first standard was issued in 1972. ASME publication ASME TDP-1-1998 is titled "Recommended Practices for the prevention of Water Damage to Steam Turbines used for Electric Power Generation". This practice covers the design, operation, inspection, testing, and maintenance of these systems. TWIP equipment is installed in the following power plant systems:

1. Main steam system, piping and drains
2. Reheat steam systems, piping and drains
3. Reheat attemperating system
4. Turbine extraction systems, piping and drains
5. Feedwater heaters, piping and drains
6. Turbine drain systems
7. Turbine steam seal system, piping and drains
8. Main steam attemperator sprays
9. Start-up systems
10. Condenser steam and water dumps

The ASME TDP-1-1998 addresses specific design and operation objectives for each one of these systems.

The Recommendations for Preventing Turbine Damage Due to Water Induction Include One or More of the Following Where Appropriate:



The diagram from TDP-1 shows a typical configuration for the Cold Reheat Drain System

1. Detection of the presence of water either in the turbine, or preferably, external to the turbine before the water has caused damage
2. Isolation of the water by manual or, preferably, automatic means after it has been detected
3. Disposal of the water by either manual or, preferably automatic means after it has been detected

The failure mode of the various devices used to prevent water induction should be considered so that a single failure of the signals will not cause water to enter the turbine.

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Major Components

1. **Condensing pot.**
   This is a piping vessel connected to the bottom of the steam line that provides a location for condensate to collect. This vessel must be of sufficient size, normally equal to the steam line, or one size smaller.

2. **Connecting Piping.**
   The level switches should be installed in a separate column that can be isolated. If the level switches are installed directly into the condensing pot, maintenance can only be performed when the steam system is shut down.

3. **Isolating Valves.**
   Enable maintenance on the probes or column if required, and also permit level system testing.

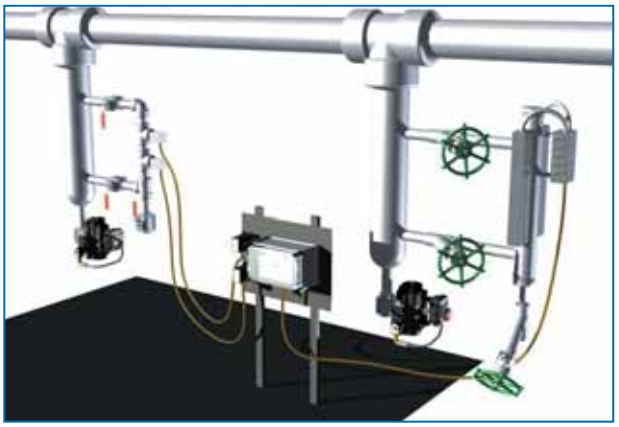
4. **Probe column.**
   Contains the probes, probe wiring, and junction box. Normally this column is made from Chrom-Moly (P11, P22, P91) or stainless steel (321H, 347H) material to accomodate the superheated steam temperatures and pressures.

5. **Column Drain and drain valve.**
   Permits blowdown of the probe column.

6. **Electronic control unit.**
   Depending on the system design, either a Single Probe Alarm Module (SPAM) or the 4 probe AQ1000P electronics unit can be used. In addition, it is possible to connect one AQ1000P electronics to probes in more than one location. The normal distance from probe to electronics should be less than 100 feet. It is very important that the electronics can accurately detect the low conductivity of condensed steam.

7. **Condensing pot drain.**
   Depending on the design, the condensing pot can be drained with a steam trap or an automatic drain valve.

Below is a depiction of a typical Aquarian Level System



Below is a photograph of a low pressure drain system. The steam trap removes the condensate under normal operation. If the trap malfunctions or the trap capacity is exceeded, the first electronic level switch (High Alarm) sends a level alarm signal to the control room. If the second level switch (High High Alarm) is activated, an automatic drain valve opens.

References

1. ASME TDP-1-1998 Recommended Practices for the Prevention of Water Damage to Steam Turbines Used for Electric power Generation
2. Aquarian Single Probe Alarm Module Brochure #9340-1105
3. Aquarian 1000P Brochure #9340-1101

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Oct/05 9340-1131