

ANCHOR DARLING DOUBLE DISC GATE VALVE STEM-WEDGE CONNECTION

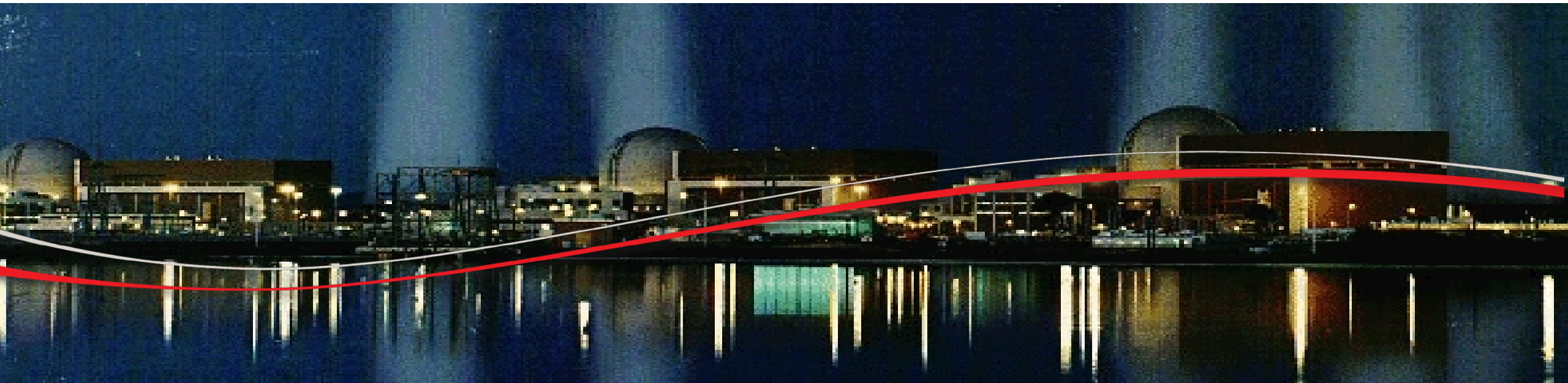
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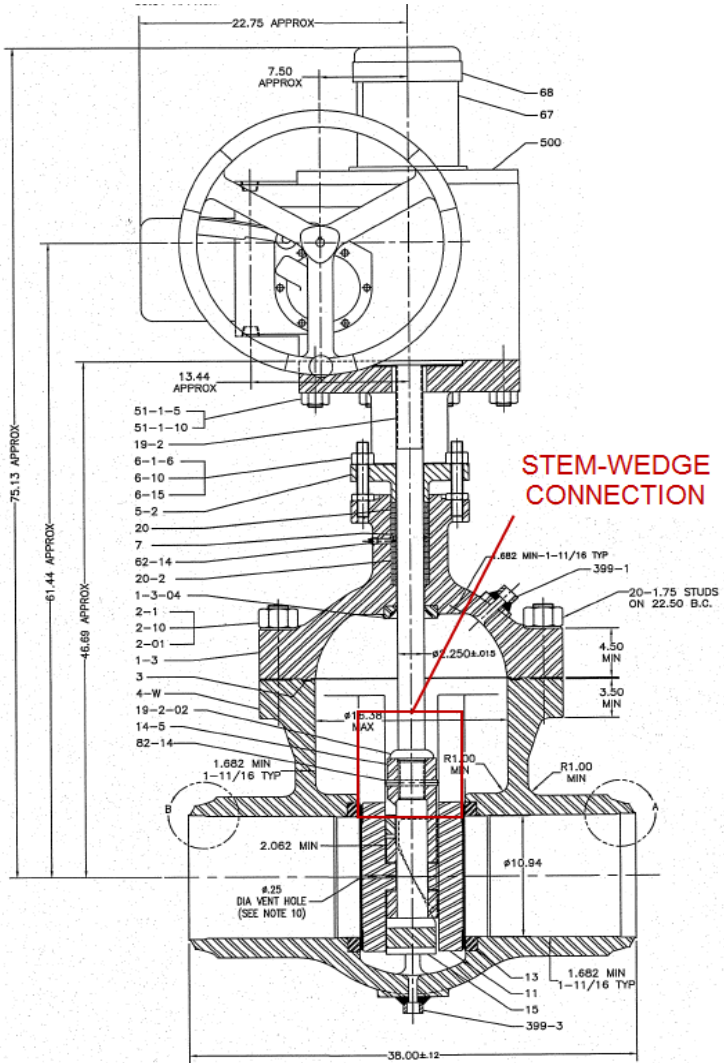
NRC MEETING June 29, 2017



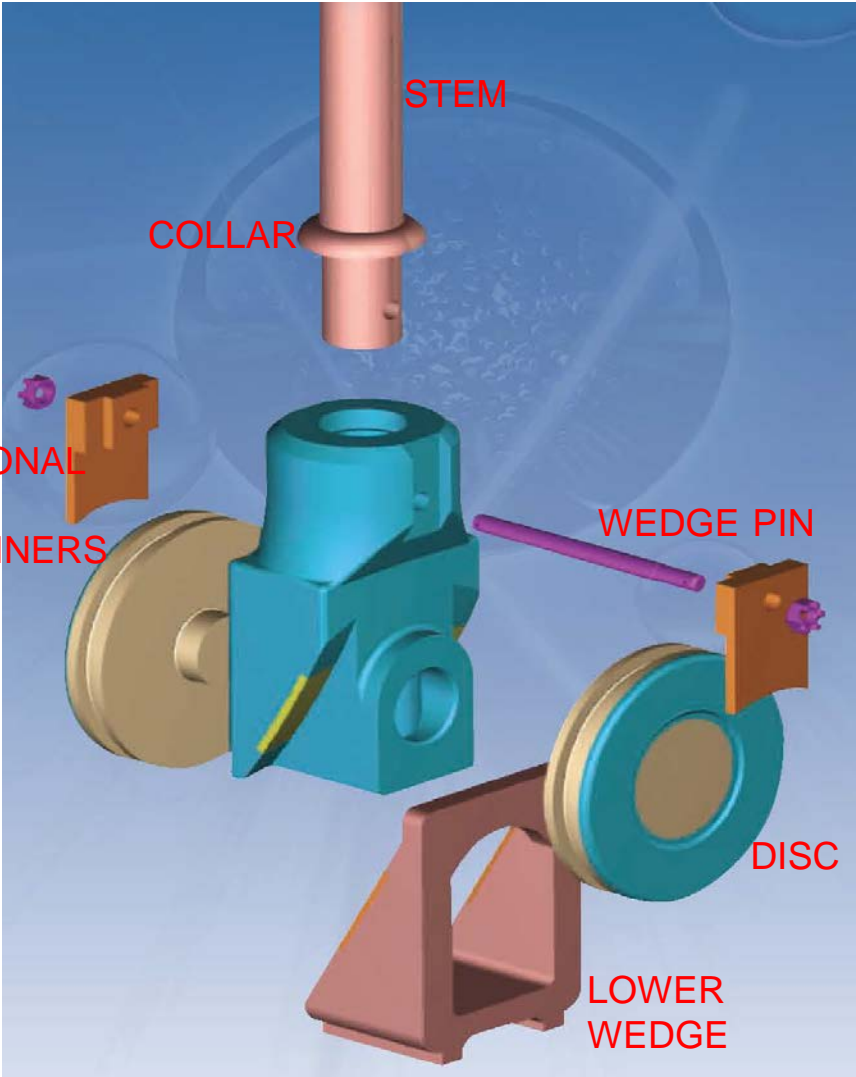
DOUBLE DISC GATE VALVE MANUFACTURERS

- 1888 DARLING VALVE & MANUFACTURING CO.
- 1971 DARLING VALVE N-STAMP CERTIFICATE
- 1973 ANCHOR/DARLING VALVE COMPANY (Anchor Equipment)
- 1997 BW/IP (Borg-Warner)
- 1997 FLOWSERVE (BW/IP and DURCO), WILLIAMSPORT, PA
- 2003 FLOWSERVE RELOCATE TO RALEIGH, NC

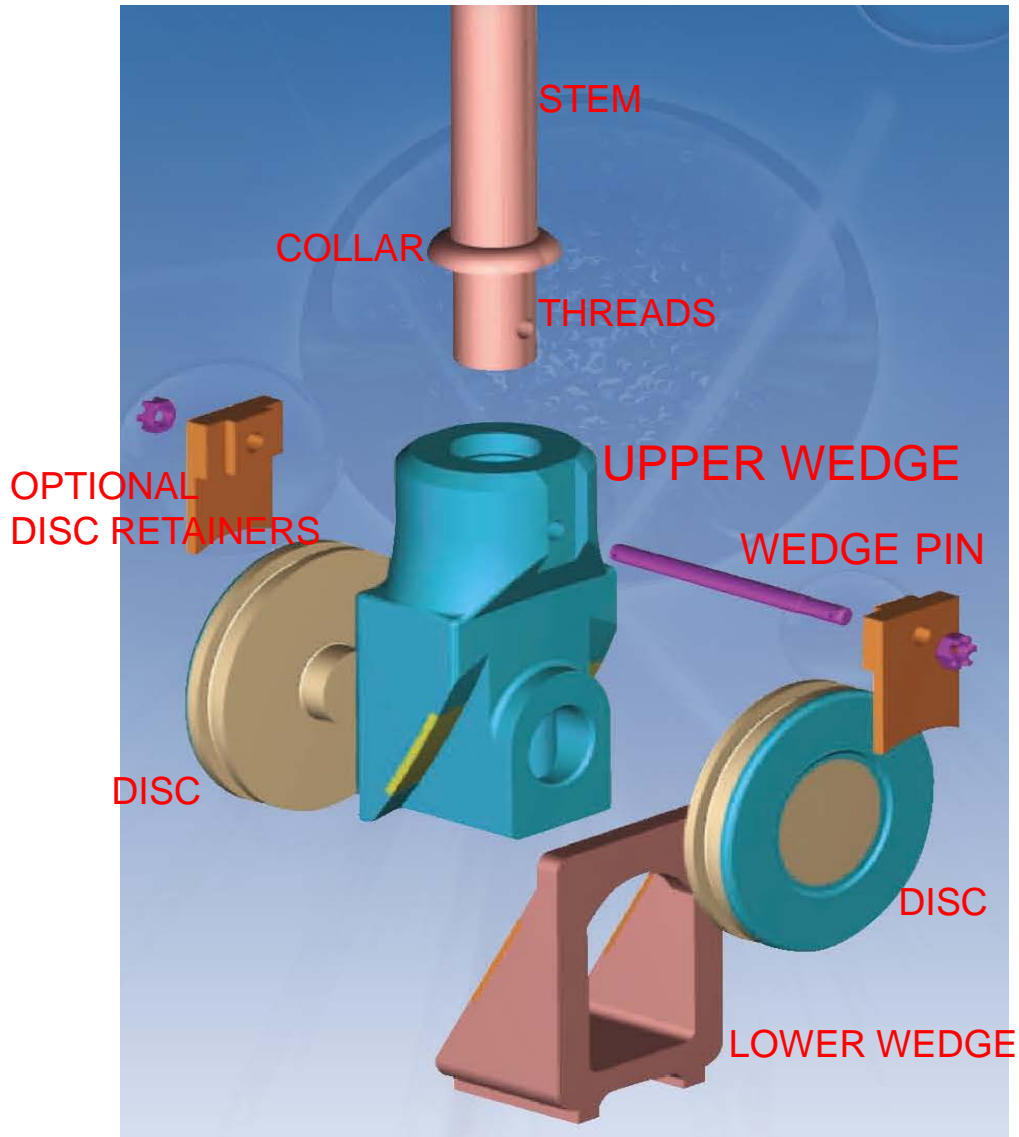
VALVE COMPONENTS



OPTIONAL DISC RETAINERS



DOUBLE DISC VALVE TRIM



- Motor Actuator operational stem torque and thrust is transmitted to the valve internals.
 - Stem
 - Upper Wedge
 - Wedge Pin
 - Disc Pack
 - Body Seats
- Stem / Upper Wedge Interface
 - Threaded and Pinned
 - Stem Collar - Pressed-on or Integral

SCOPE OF POTENTIAL STEM CONNECTION ISSUE

Flowserve - Anchor/Darling Double Disc Gate Valve with Wedge Pins Subjected to Potentially Damaging Forces

- Threaded Stem-Wedge Connections Subjected to Stem Torque
- Safety-Related, Motor Operated Valves
- Valve Sizes: 2" and Larger
- Pressure Classes 150 through 2500

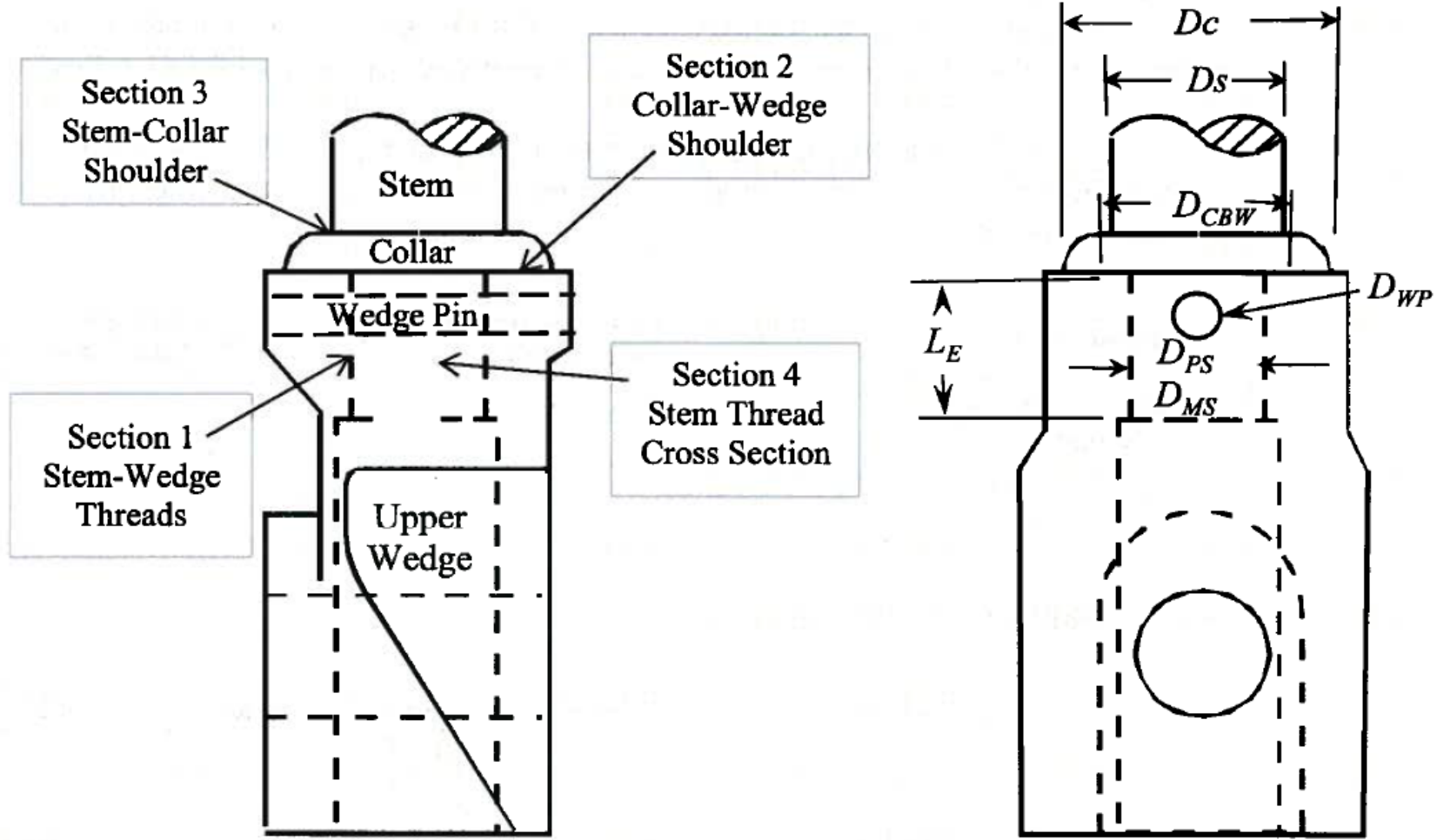
LaSALLE STEM-WEDGE SEPARATION

- Working with Exelon and BWROG to evaluate and address the issue.
- Stem threads had no or limited preload.
 - Pressed-on stem collar could not support the stem thrust, so any preload would have been reduced or lost.
- Loose joint reduced friction loads which allowed more load on wedge pin.
- Stem torque exceeded the wedge pin capability.
- Repeated high stem loads caused continued thread wear and joint degradation.
- Worn wedge threads eventually failed in shear from stem thrust.

CONNECTION TO FEBRUARY 2013 NOTIFICATION

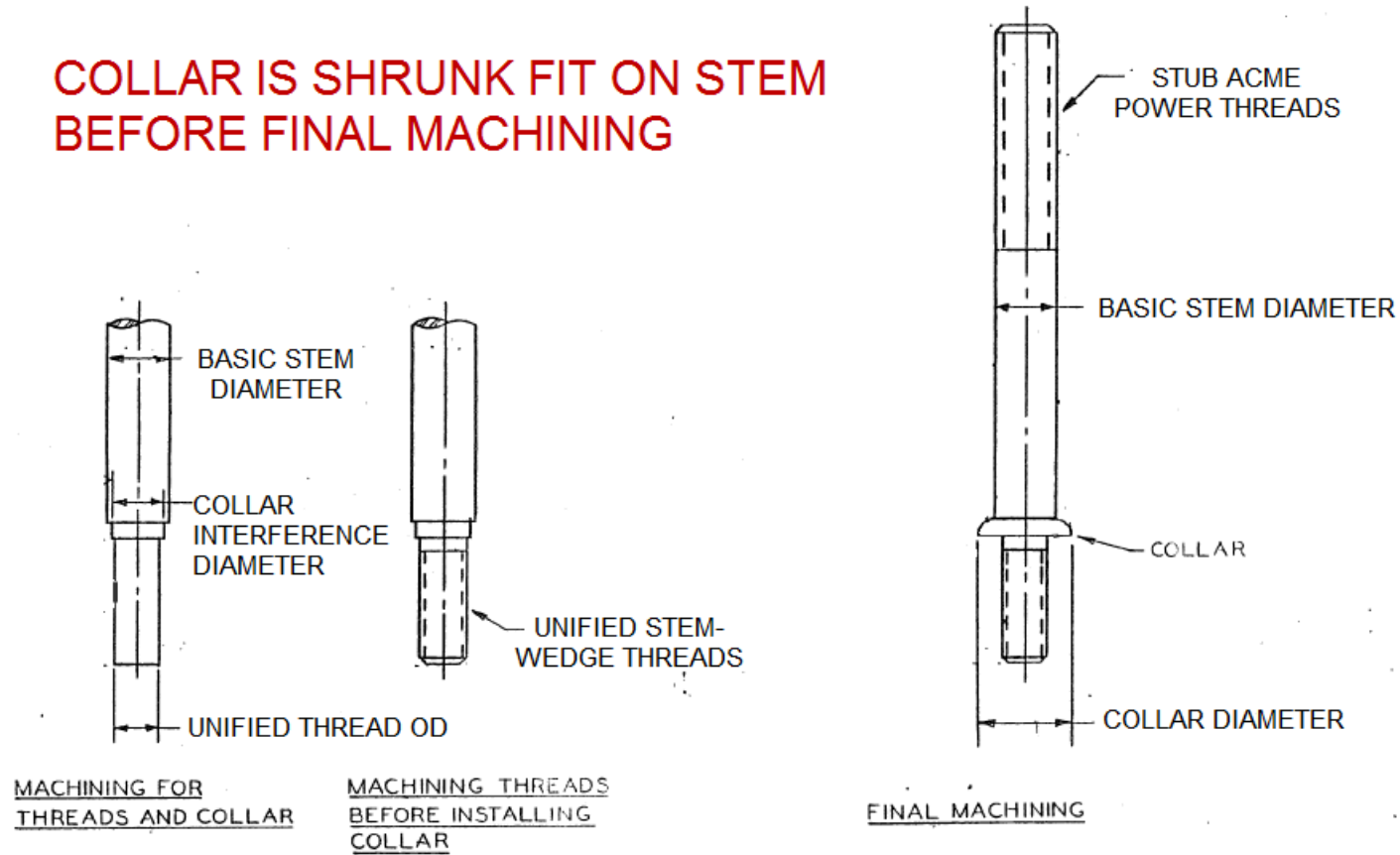
- Wedge pin failed in shear at TVA – Browns Ferry
- Stem did not separate from the wedge and valve could operate
- Concern was pin failure could lead to joint degradation
- LaSalle event proceeded further to stem-wedge separation
- Stem thread preload prevents high loads on the wedge pin
- Without an adequate preload the pin strength is important to maintain joint integrity
- Preload can be reduced if the stem thrust is greater than the allowable, which is limited with a stem using a pressed-on collar

CRITICAL SECTIONS OF STEM-WEDGE CONNECTION



STEM WITH PRESSED ON COLLAR

COLLAR IS SHRUNK FIT ON STEM BEFORE FINAL MACHINING



UPDATES TO PREVIOUS EVALUATION & ACTIONS

- Valves with wedge pins that can support the torque without a preload are not susceptible and require no additional action.
- Valves with wedge pins that cannot independently support the torque must be evaluated for stem thrust collar capability.

PRELIMINARY RECOMMENDATIONS

- Preload the stem into the wedge during assembly
- Use the maximum preload base on joint strength
- If stems are replaced use stems with integral collars
- If wedge pins are replaced use high strength material
- Review weak-link / maximum thrust evaluations.
 - Thrust limit to maintain the preload.
 - Pressed-on collars will have reduced limits.

QUESTIONS?

