NUCLEAR VALVES LATEST DEVELOPMENT

A. Motor Operated Gate Valves capable to resist Stall Torque

B. Contribution to Cobalt free Hardfacing

C. Quick Maintenance Valve

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A. MOTOR OPERATED GATE VALVES CAPABLE TO RESIST STALL TORQUE

INTRODUCTION

In the frame of Nuclear Power Plant upgrade (Emergency Power Supply and Emergency Core Cooling), Westinghouse had to face a new valve design philosophy specially for motor operated valves.
The valves have to be designed to resist any operating conditions, postulated accident or loss of control.
The requirements for motor operated are listed hereafter.
In a common approach the valve manufacturer, Alsthom Velan and Westinghouse have completely reconsidered the valve design including parameters and coefficients justification. The selected model and related upgrading is explained hereafter.
(87 gate valves have been recently supplied to Switzerland).

1. DESIGN BASIS REVIEW

1.1 Power Supply conditions
- Un : 380V +10/-15%, 3ph, 50 Hz ±2%
- Full load at 0,75 Un during 3 minutes
- Full load at 0,7 Un during 12 seconds
- Starting at 0,85 Un
- Full load at 50 Hz ±10% during 5 seconds
- Fast transfer from main grid to emergency grid

1.2 System requirements

- Line design Pressure, Temperature and Differential Pressure, based on specific condition (not only rating ANSI B16.34) analysed on a case by case basis
- Stroke time defined from operation conditions and system / instrumentation requirements and limitations.

1.3 Safety, integrity and operation requirements

- Loss of Power Control; postulated failure of :
  Limit Switch
  Torque Switch
  Thermal overload switch / fuse
  Electrical overload switch / fuse
- Stall torque applied at full speed.
- Impact on pressure boundary and operation to address with 0,9 Sy (code design value) as allowable.
- Margin between stall torque at 0,85 Un and required torque equal to 1,6 .. 2
- Torque switch setting margin

1.4 Valve and Motor Operator fundamental design basis

- Construction Code : ASME III Safety Class 1
  IEEE Class 1E
  Seismic class 1
- Design Life : 40 years (2000 cycles)
- Environment : LOCA conditions. Active during and after.

2. VALVE DESIGN REVIEW

2.1 Selected Model :

- Motor Operated Parallel Gate Valves
- ANSI B16.34 rating 150 lbs to 1525 lbs stainless steel type 316L
- . Stroke Mechanical Stops. Opening : back seat
  Closing : upper stem stop.
  . Live load packing
  . Hardfaced back seat
- The parallel slide Gate Valve design has been selected due to its advantage regarding the stall torque behaviour :
  . the internal sealing components, such as disc seats are not involved during the motor stall.
  . the risk of Stem Buckling is totally avoided.
  . the " Weak Link " is always outside pressure boundary.

3. VALVE CALCULATION

3.1 Parameter justification :

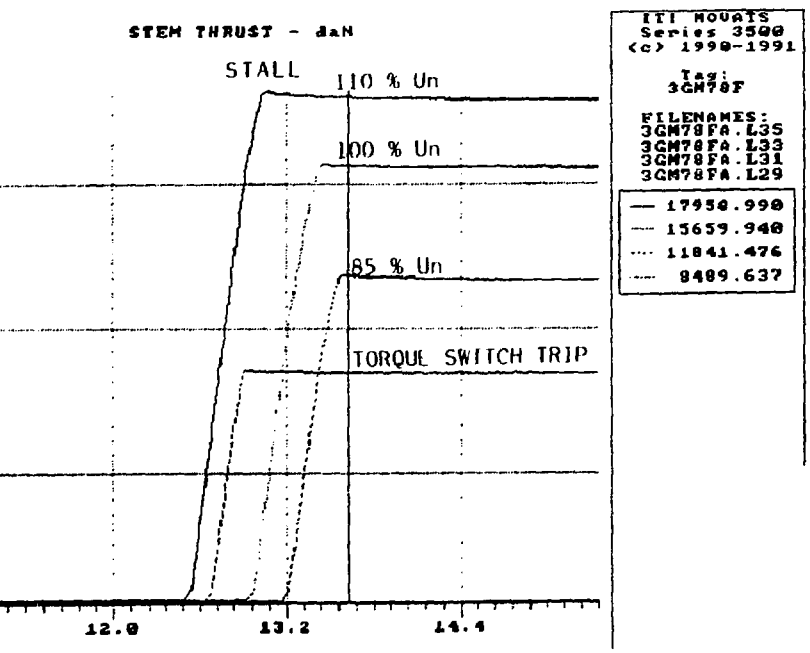
- Friction coefficient
- Operator efficiency

3.2 Calculation results :

- Maximum expected torque values (488 Nm)
- Required torque (150 Nm)
- Stall torque maximum allowable 687 Nm at 0,9 Sy code
- Stall torque maximum measured 613 Nm at 10 % Un

4. TEST RESULTS (Monitoring with ITI MOVATS 3500)

Stem thrust in opening direction. (daN)



B. CONTRIBUTION TO COBALT FREE HARDFACING

INTRODUCTION

As part of plant upgrade and valves replacement, Westinghouse has sponsored alternative hardfacing research program.
Two types of materials have been investigated ; Nickel base Alloys and Iron base Alloys ; program requirements and test result are given hereafter.
(150 check valves, 400 manual and air operated globe valves have been supplied for Switzerland).

1. QUALIFICATION PROGRAM

- Hardfacing applied where recommended by manufacturer
- Cobalt content limited to 0.2 %
- Qualification procedure
  - . Weldability procedure and operator qualification
  - . Thermal shock resistance
  - . Corrosion resistance
  - . Wear resistance
  - . Endurance 2000 cycles at pressure, temperature and differential pressure

2. RESULTS

2.1 PHASE 1

Qualification program has been performed on prototype valves.
The results for Iron base Alloys are satisfactory.
Nickel base Alloys produce also satisfatory results however the thermal shock resistance depends highly on seat/body configuration and welding parameters. Therefore Iron base Alloys have been selected for implementation on check valves (swing and lift types) and globe valves.

2.2 PHASE 2

The compliance with the qualification program has been demonstrated *using differents facilities of Alsthom Velan Laboratory : seat* friction bench, thermal shocks bench, hot cycling test loop.
The results for Ni based Alloy are satisfactory except for wear test, therefore the use of Ni base Alloys is restricted to valves where friction is low : globe valve, check valve.
Research Program is proceeding further on for Iron base Alloys and more sophisticated materials as ceramics.

3. CONCLUSION

Nickel base and Iron base Alloys have been demonstrated satisfactory for use on all valves types except gate valves, however the implementation of these Cobalt Free hardfacing Alloys are much more difficult than stellite and results from one procedure and geometry to another one or to another manufacturer are unpredictable and have to be transposed very carefully.
Therefore each time a new application is foreseen, we recommend that a complete qualification test program is performed.

C. QUICK MAINTENANCE VALVE

INTRODUCTION

Quick maintenance is becoming a very important requirement for circuits with high operating cost or for valves located in high irradiation areas. Alsthom Velan has developped a new globe valve model (On-Off or regulating) that permits the seat replacement in less than 10 min.
(8 air operated and 4 manual globe valves for Letdown and Excess Letdown lines).

1. BASIS REQUIREMENTS

- Design Basis :Safety Class 1 (RCC M-B or ASME - NB,NC)
  IEEE Class 1E
  Seismic Class 1, 150 to 1525 lbs, DN 8 to 50
  Design Life : 40 years (2000 cycles)
- Environment : LOCA conditions
- Zero leakage through atmosphere

2. VALVE CHARACTERISTIC

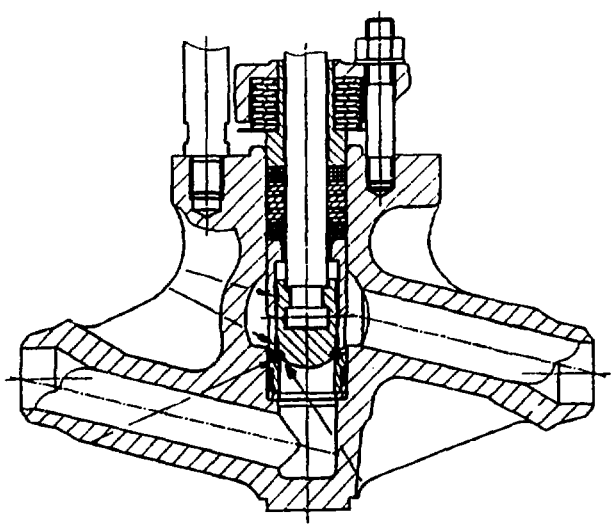
A removable seat fitted with a seal ensuring the tightness between the seat and the single-piece body is maintained in place by an assembly consisting of :

- a cage,
- packing gland and flange,
- a live loading arrangement.

This design enables, thanks to simple operations and according to guaranteed preset times :

- the repair of packing box, using as spare parts non split packings improving thus the efficiency.
- the replacement of seat, the number of interventions not being limited.

The replacement of seat is carried out by maintaining the body of valve on piping. This enables to suit it to local operation conditions by possibly modifying its nature and shape. Moreover, the lapping made in workshops under optimal conditions ensures a maximal internal sealing, reduces the intervention time on site and limits the exposition to radiations during field work in nuclear power plants.



"RAMA" VALVE

PRINCIPLE