Machine Protection Panel Meeting

TT60 vacuum interlock issue

G. Pigny

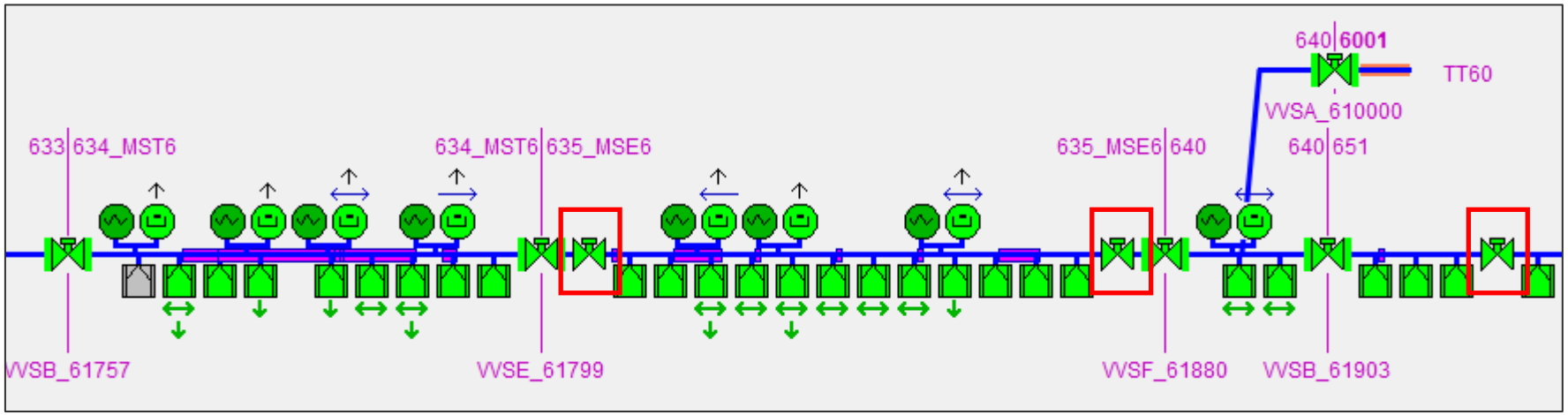
On behalf of the **TE-VSC** Group

Outline

- Fast valves in SPS
- The event and consequences
- Fast valve behaviour and control system
- Sequence of events
- Short, medium, long-term solutions

Fast valves in SPS

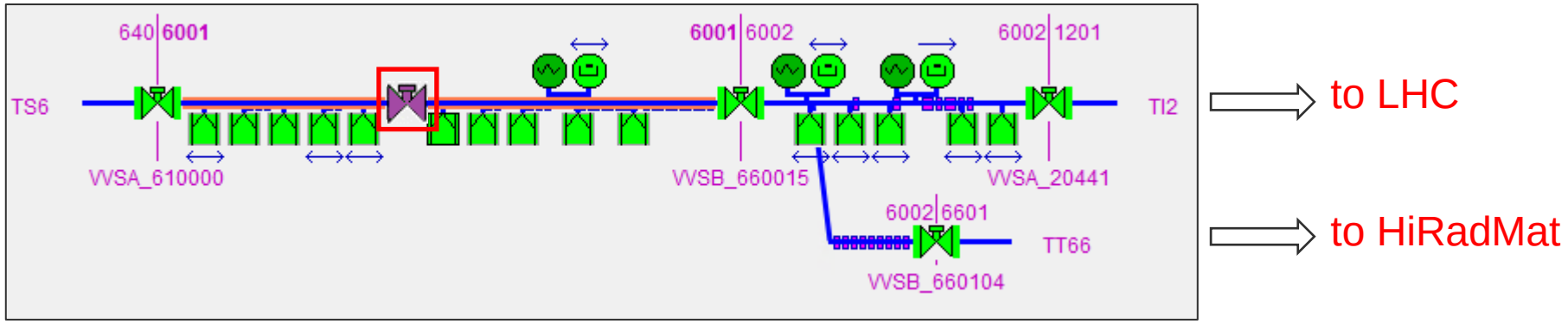
- Originally installed to protect septa against a sudden pressure rise (closing time <50ms).
- Two types of actuation: electric (VVFA) and electropneumatic (VVFB).
- Located at the extraction zones of LSS2 (1x VVFA, 2x VVFB), LSS4 (1x VVFA), LSS6 (3x VVFA, 2x VVFB) and TT60 (1x VVFA).
- VVFA locally powered from the tunnel (230VAC) and controlled from the racks (BA).
- Obsolete equipment without a replacement candidate (keeping old spares).



SPS Vacuum SCADA application: fast valves in LSS6

The event and consequences

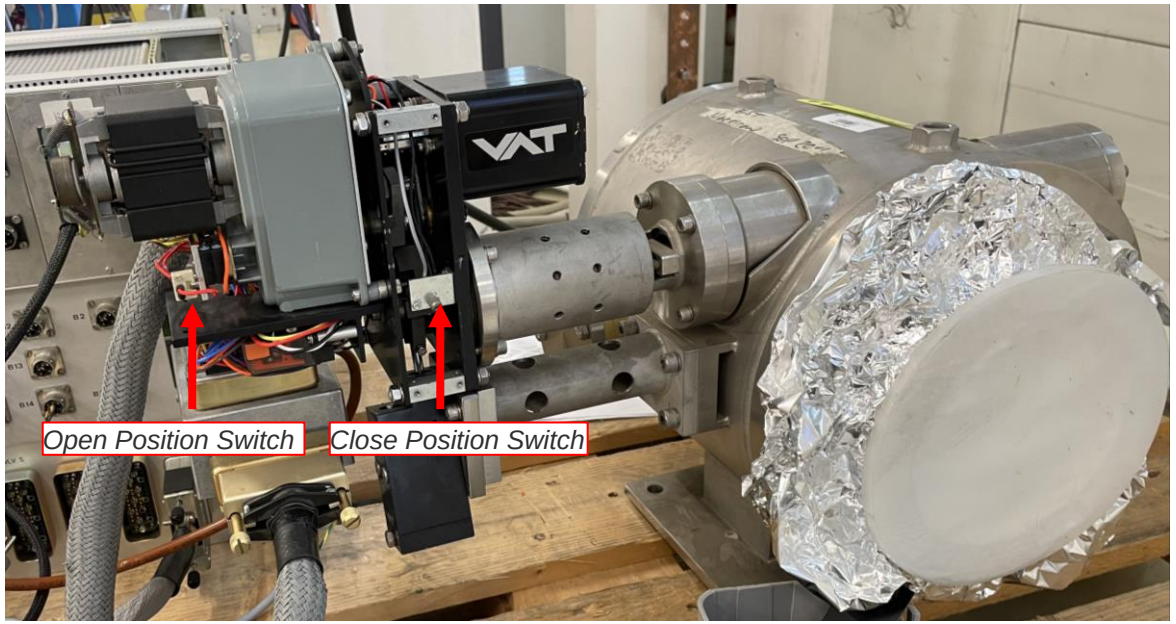
- 07-04-2023 21:00 => The fast valve located in TT60 (VVFA_610213) goes into error (switches Open & Closed both activated).
- 08-04-2023 ~14:00 => Vacuum piquet realizes the problem and intervenes to check it.
- 08-04-2023 ~16:19 => Vacuum piquet solves the problem (missing 230 VAC supply).
- From 07-04-2023 21:00 to 08-04-2023 14:00
  - Several beam injections (440 GeV, 1e11 p) to LHC/HiRadMat with the valve in error (physically closed).

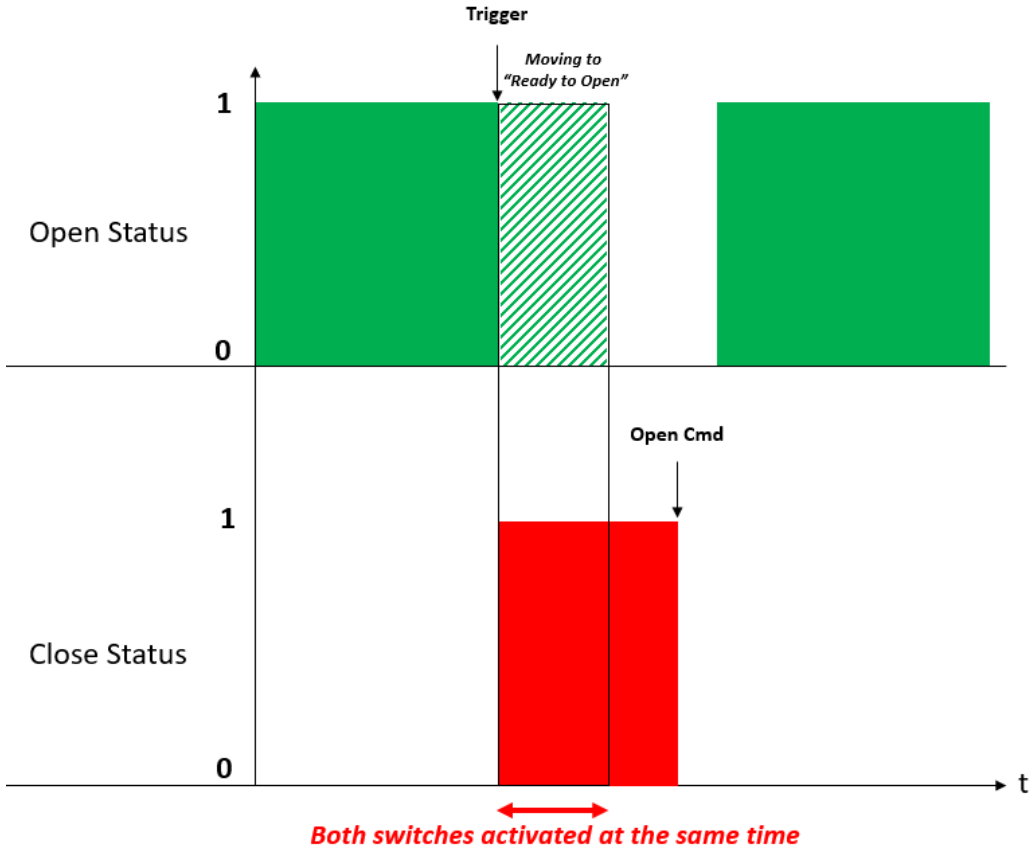


SPS Vacuum SCADA application: fast valve in error in TT60

Fast Valve Behaviour

- Close Position switch immediately active after triggering the valve (activated by spring closing mechanism).
- Open Position switch still active until valve moves to the “Ready to Open” position (activated by motor shaft).





Fast valve control system (before the event)

"Fast" valve

"Fast" valve controller

Sector valve card

Vacuum Beam Interlock Crate

Beam Interlock User Interface

Vacuum user permit

Interlock

Penning gauge controller

Profibus

PLC

Ethernet to SCADA

Penning gauge

Sequence of events

1. We lose the 230 VAC to locally supply the valve in the tunnel while the valve is open
   - 230 VAC are used to move the valve to “Ready to Open” and Open positions.
   - 230 VAC feedback only available locally at the controller level.
2. On April 7 at 21h01, there is a pressure rise generating a vacuum interlock, and the interlock input is not disabled as it should, which triggers the fast valve closing
   - Pressure rise in gauge VGHB_610405 shorter than SCADA acquisition time (1Hz), therefore not visible.
3. The valve closes but does not move to “Ready to Open position” because there is not 230 VAC local power
   - Therefore, both switches remain activated.
4. Sector valve card only evaluates the “Open” status for the Beam Interlock Control
   - Therefore, it does not generate an interlock to dump the beam or disable the injection.

Implemented solutions

- **Short term solutions**
  - Check the 230VAC presence during commissioning (rack side)
    - Enforced from April 2023 onward
  - Disconnect the interlock cables to not trigger fast valve closure (rack side)
    - Done after April 2023 event
  - Tighten the 230VAC extension cables in the tunnel to avoid any accidental disconnection
    - Done during TS June 2023

Fast valve control system (after the event)

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"Fast" valve controller

Sector valve card

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- **Medium term solution**
  - Implementation of PLC-based interlock to the BIC evaluating both statuses
  - Vacuum user permit TRUE only if the Fast valve is Open and not Closed
    - Implemented during YETS23-24

Fast valve control system (after YETS23-24)

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"Fast" valve controller

Sector valve card

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- **Medium term solution**
  - Implementation of PLC-based interlock to the BIC evaluating both statuses
  - Vacuum user permit TRUE only if the Fast valve is Open and not Closed
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- **Long term solution**
  - Removal of all fast valves in SPS during LS3. ECR preparation on going, will be sent in 2025 for approval.

THANK YOU