DPS Summary

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NATIONAL ACCELERATOR



Facility for Advanced Accelerator Experimental Tests

> Stanford University



Outline

- Summary of hardware
- Performance
- DPS for operators
 - Vacuum page
 - Watcher
 - Hardware locations
 - How to troubleshoot
- DPS for users
 - Current performance

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- Control panels and instructions for use

Overview of DPS system

- Required to allow experimental gasses up to few Torr in the IP, while:
 - Maintaining nTorr at XTCAV and linac
 - << mTorr in spectrometer to limit emittance growth (in fact we can maintain <1e-6 Torr)
 - No solid material in the beam path i.e. Be windows
- Two systems running in parallel
 - US-DPS (upstream): 4x turbopumps and 2x roughing pumps
 - DS-DPS (downstream): 2x turbopumps and 2x roughing pumps



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Schematic of the system



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Schematic of the system – foreline system



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Summary of hardware

- Turbopumps: Ebara EMT2204 ~2000 l/s mag-lev turbos
 - Pumps directly on beamline
 - Controllers are in gallery:
 - 4 US pump controllers at Penetration 20-10
 - 2 DS pump controllers at Penetration 20-12
- Roughing pumps: Ebara EVS-100P- 10,000 I/s
 - Pumps installed under the beamline, directly below the turbos
 - No remote controller, but remote status panel in rack FKG20-24
 - Powered from circuit breaker 2PK102E2
- Foreline valves between turbos and roughing pumps
 - Interlocked to foreline pressure
 - Controllable through EPICS
- Beamline valves
 - Interlocked to beamline pressures





DPS Overview

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Main failure modes – in order of likeliness

Trip:	Sign of the fault
Radiation trips roughing pump	 Foreline pressure rise → Foreline valve closes → Watcher shuts off turbo → message to FACET elog Could result in beamline pressure rise, depending on conditions of trip → beamline valves go in, MPS fault Pump statuses show off and probably an error message (deep in status panels)
Turbopump trip	 TMP stops → Watcher should notice and close foreline valve → message to elog. Could result in beamline pressure rise, depending on conditions of trip → beamline valves go in, MPS fault
DPS watcher glitch – i.e. bad input	 Usually results in watcher stopping a TMP and closing a foreline valve → message to elog
Some other service glitch	• If a pump overheats, or shuts itself off, then the interlocks/watcher should intervene

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For Example – US1 roughing pump failure



For Example – US1 roughing pump failure



How to troubleshoot

- 1. Determine what pump is the problem
 - Check the vacuum schematic -
 - First look at pressures •
 - Then look at pumps
 - Check the message in the elog
- 2. Once you find the problem pump – see what's up
 - open the pump panel and click "More..." to see the warning/alarm statuses -
 - Turbopump status panel and roughing pump status panel shown above
- 3. More info here:
 - https://confluence.slac.stanford.edu/display/FACET/DPS+Pump+Troubleshooting -

Note!

- The forelines are reconfigurable, so be aware of the flow of gas. -
- Generally, gas will flow from a lower pressure volume, through a working pump, into a higher pressure volume.
- Do not open/close any foreline valve with a letter suffix, i.e. FV-DS2a -



/acuum Turbomolecular Pump

VPTM:LI20:3291:DS2

Target Speed

Status

Status

Speed

Current

Lifetime

Error Code

FACET

Touchdown Cour

Temperature

Main failure modes – How to try to clear a fault

•	https://confluence.slac.stanford.edu/c	<pre>isplay/FACET/DPS+Pump+Troubleshooting</pre>
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Trip:	Sign of the fault	Things to try					
Radiation trips roughing pump	 Foreline pressure rise, Foreline valve closed turbo stopped Warning and/or Alarm code 	 Hit "Reset" on roughing pump panel If error does not clear, then try again over a few minutes Reset the power to the pump (cycle circuit breaker) Sometimes an extended time with no power brings the pump back (i.e. ~30 minutes) 					
Turbopump trip	 TMP stops Foreline valve closed Foreline pressure is still low "Failure" or "Alarm" code 	 Hit "Reset" on turbopump panel If error does not clear, then try again over a few minutes Cycle the power on the controller in the gallery (power switch is on the back) 					
DPS watcher glitch – i.e. bad input	 Things are off, but no errors 	 Check EPICs to see if the readback looks ok Usually this is a temporary glitch Check that the watcher is still running (restart if its not) 					
Some other service glitch	• Things are off, but no errors, or error in temp or water flow	1) Call for help					
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How to restart a DPS stage

Confluence page:

- <u>https://confluence.slac.stanford.edu/display/FACET/Restarting+DPS+pumps#RestartingDPSpumps-</u> <u>StartingorRestartingtheDS-DPSpumpswhenthebeamlineisundervacuum</u>
- Basic steps are:
 - Start the roughing pump, or ensure it is running:
 - Check that the foreline pressure is good i.e. <1e-2 Torr, and clear interlocks
 - Start the turbopump
 - When then turbo speed is >5000RPM, then open the foreline valve
 - Watch to make sure the turbo reaches the full speed and the foreline valve stays open
- Things to watch out for
 - The watcher sometimes interferes. you may need to stop it, then restart after pumps are sorted
 - Interlocks can be tricky to manage. If you don't understand EXACTLY what you are doing, then you shouldn't be messing with them



Summary of confluence articles:

- DPS trouble shooting guide:
 - https://confluence.slac.stanford.edu/display/FACET/DPS+Pump+Troubleshooting
- How to guides:
 - Gas jet with DPS: <u>https://confluence.slac.stanford.edu/display/FACET/How+to+DPS+with+Gas+Jets</u>
 - Stop the DPS pumps: https://confluence.slac.stanford.edu/pages/viewpage.action?pageId=349294120
 - Restart DPS pumps:

https://confluence.slac.stanford.edu/display/FACET/Restarting+DPS+pumps

DPS performance

- Can support 4 modes of operation:
- No straws or apertures installed, but the Be windows are left as-is
 - US Be window is fixed, and has large holes
 - DS Be window is removable, but also has holes
- Radiation shielding has been added to the downstream roughing pumps

Mode:	Gas:	Pressure:
0: High vacuum	none	1e-6 at IP, 1e-9 in US-DPS/DS-DPS
1: Li oven	Не	\leq 5 Torr at IP (US-Be to DS-Be)
2: H2 plasma	H ₂	\leq 5 Torr at IP (US-Be to DS-Be)
3: Gas jets	He, H ₂	Ok to 10 Hz, depending on backing pressure + opening time. No DS-Be required



DS1 Roughing Pump

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DPS performance – static fill

- Better than %-level stability over hours (until radiation trip)
- Improvements since 2022 run mean up to 5 Torr H2 is possible with addition of purge gas into the roughing pump
- Still tricky to manage the gas fill (local control only)



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DPS performance – Gas jets

- Problems earlier in the summer when the gas jets were set to long opening time
 - Fixed on IOTA controller
- Main limitation now comes from the picnic basket turbo evacuating gas between shots
 - US4 pressures good to 1200 psi He
 - Need to retest with H2 with purge gas
- Nominal operating mode is to stop gas when not actively take data/aligning



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DPS operation with Gas Jets, from a user perspective

- DPS with gas jets has been well practiced and many kinks worked out
- Control by trained users is encouraged!
 - <u>https://confluence.slac.stanford.edu/display/FACET/How+to+DPS+with+Gas+Jets</u>
- Gas jet control panel contains controls and status summaries
 - Gas supply status (EPS)
 - Pressures
 - Simplified gas jet controls
 - DPS status
 - Beamline valve statuses
 - Beamline pressure
 - Turbo statuses
- Anything red means trouble

Gas jet control panel			Home Exit
Gas Jet Controls			
Gas 1 & 2 Supply	0.1 Torr Gauge: 0.00 VPTM Gauge: 2.90e-07	10 Torr Gauge: 0.00 1000 Torr Gauge: 0.80	E-300 Oven
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DPS			
VV:3160 - US Beamline Valve US4 Gauge: 9.08 TCAV Gauge 2.40	e-10 DS2 Gau	ge: 1.98e-09 VV:325 uge: 1.40e-07	0 - DS Beamline Valve
DPS Full Schematic	Open	DPS_Gasjet_Pressures.st	p: Strip Tool
3108:US4 3130:US3 US-DPS Turbo Statuses:	3151:US2 3171:US1	32 -DPS Turbo Statuses:	59.DS1 3291:DS2
PRODUCTION FACET			08/01/2022 19:07:24
DPS Overview			

DPS operation with static fill, from a user perspective

- This is trickier to manage.... Not ready for prime time yet
- Things to sort out to make this user friendly
 - Remote management of the gas supply
 - Robustness of pumps (hopefully shielding works)
 - Integration into E300 control panel



Questions?



