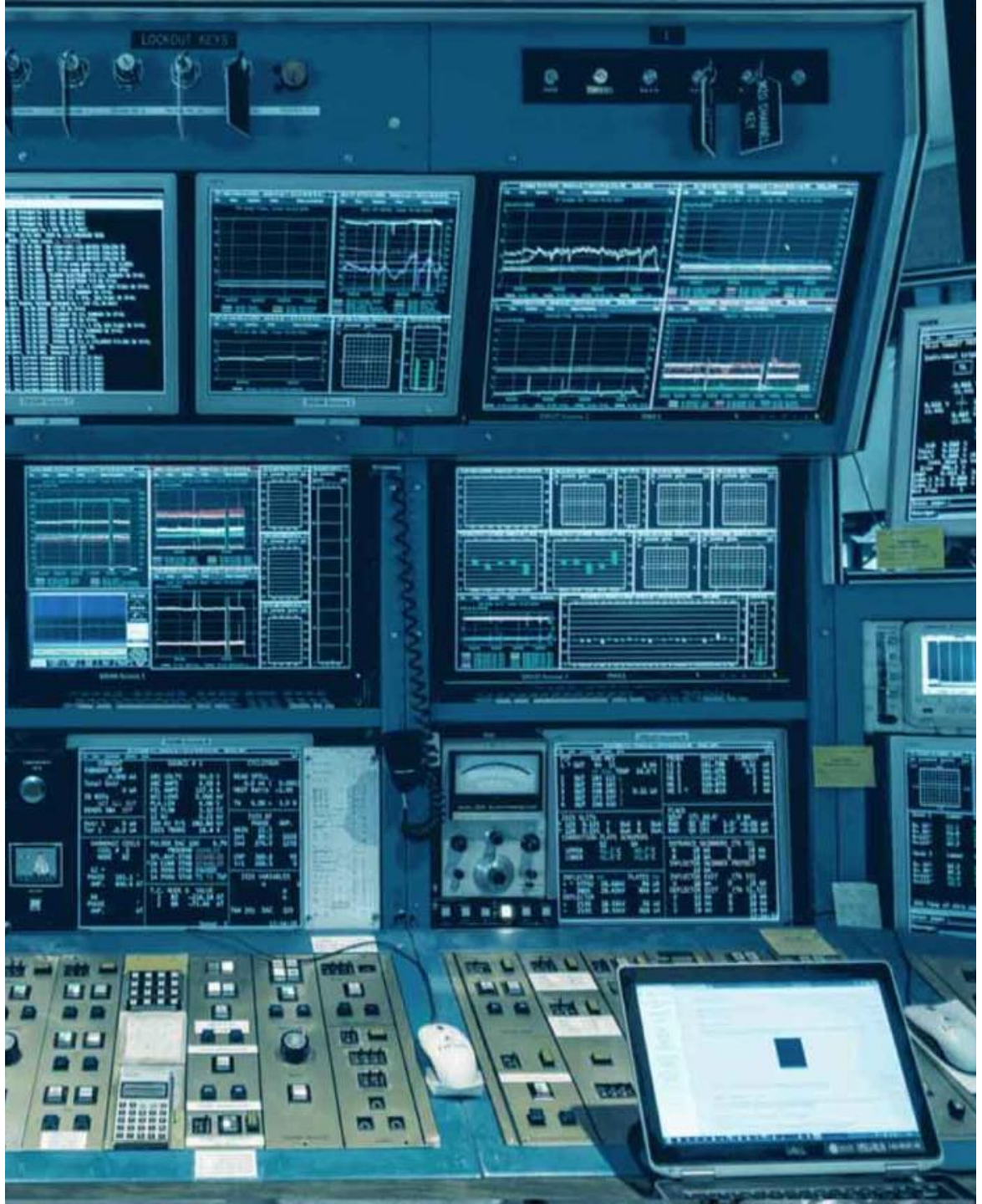
TRIUMF

When two become one: Transitioning from the operation of one to two accelerators

Kathleen Genge

Operator, Driver Operations
Accelerator Division
TRIUMF
Vancouver, B.C. Canada
genge@triumf.ca

2018-10-04



Discovery, accelerated

TRIUMF

WAO 2016 Shanghai

TRIUMF

Canada's national laboratory for particle and nuclear physics
Laboratoire national canadien pour la recherche en physique nucléaire
et en physique des particules

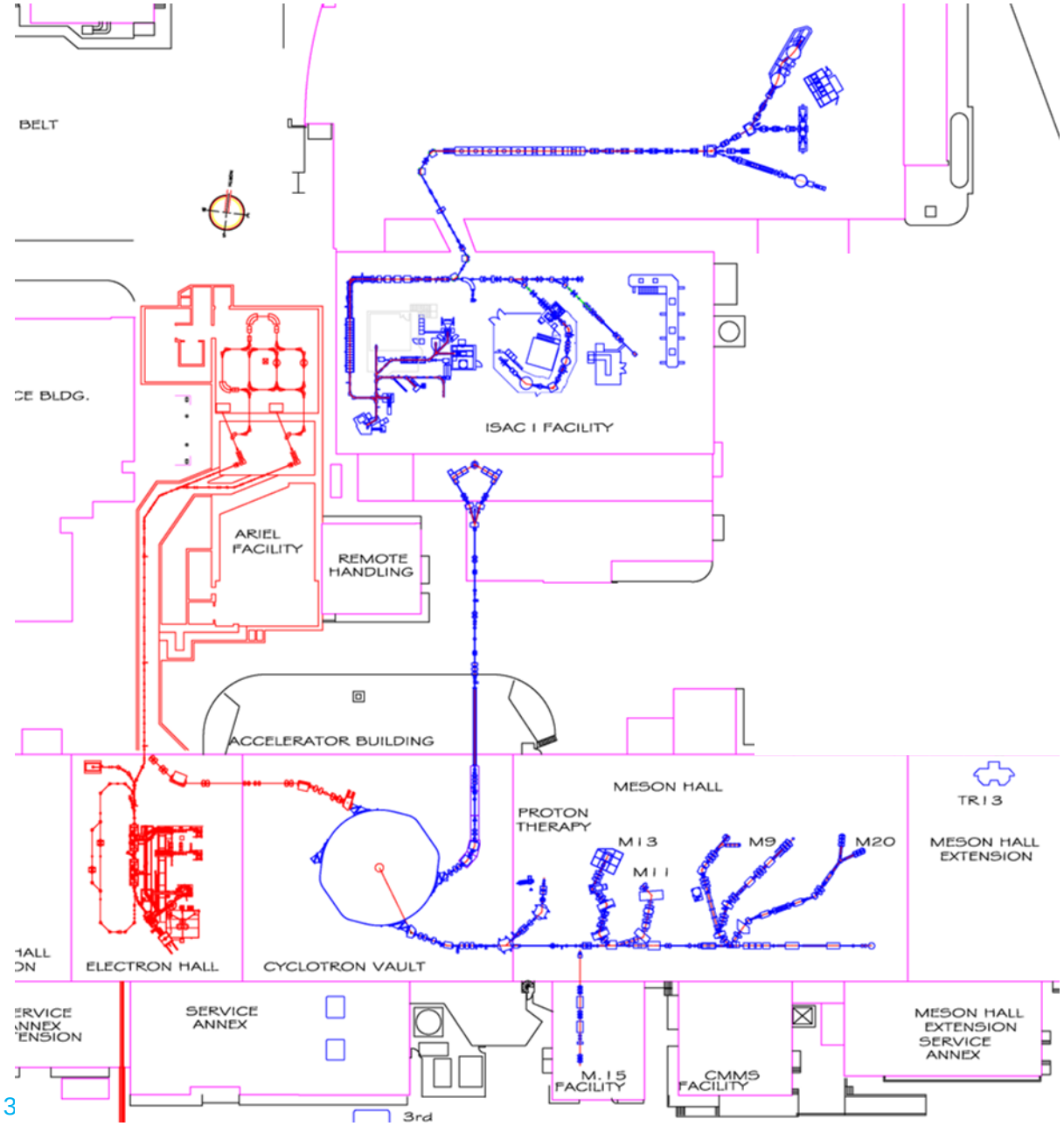
When Less is More

Building an Operations Group from Scratch.. Kind of..

Violeta Toma
TRIUMF, Canada

Discovery, accelerated

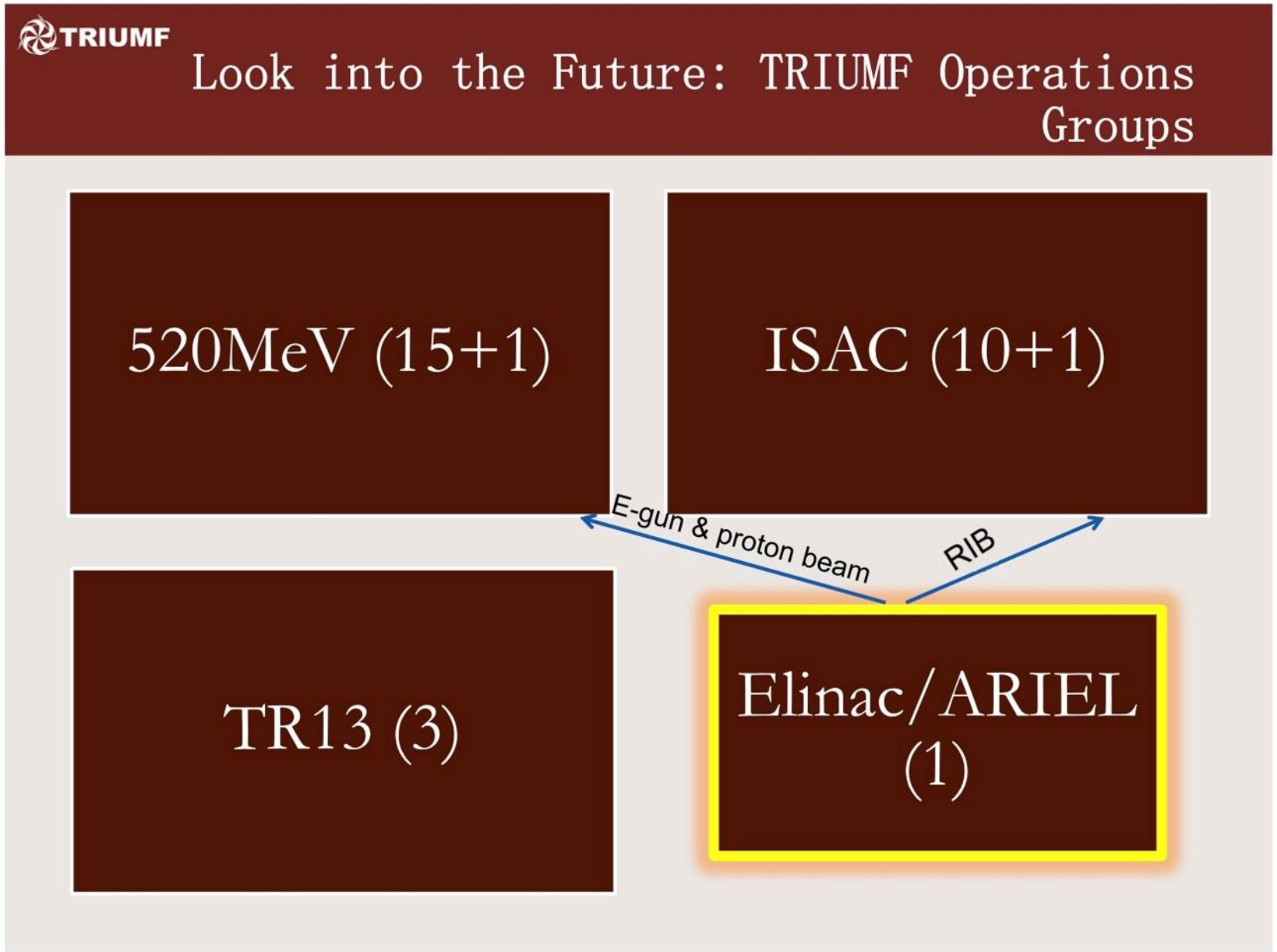
Accelerator Operations



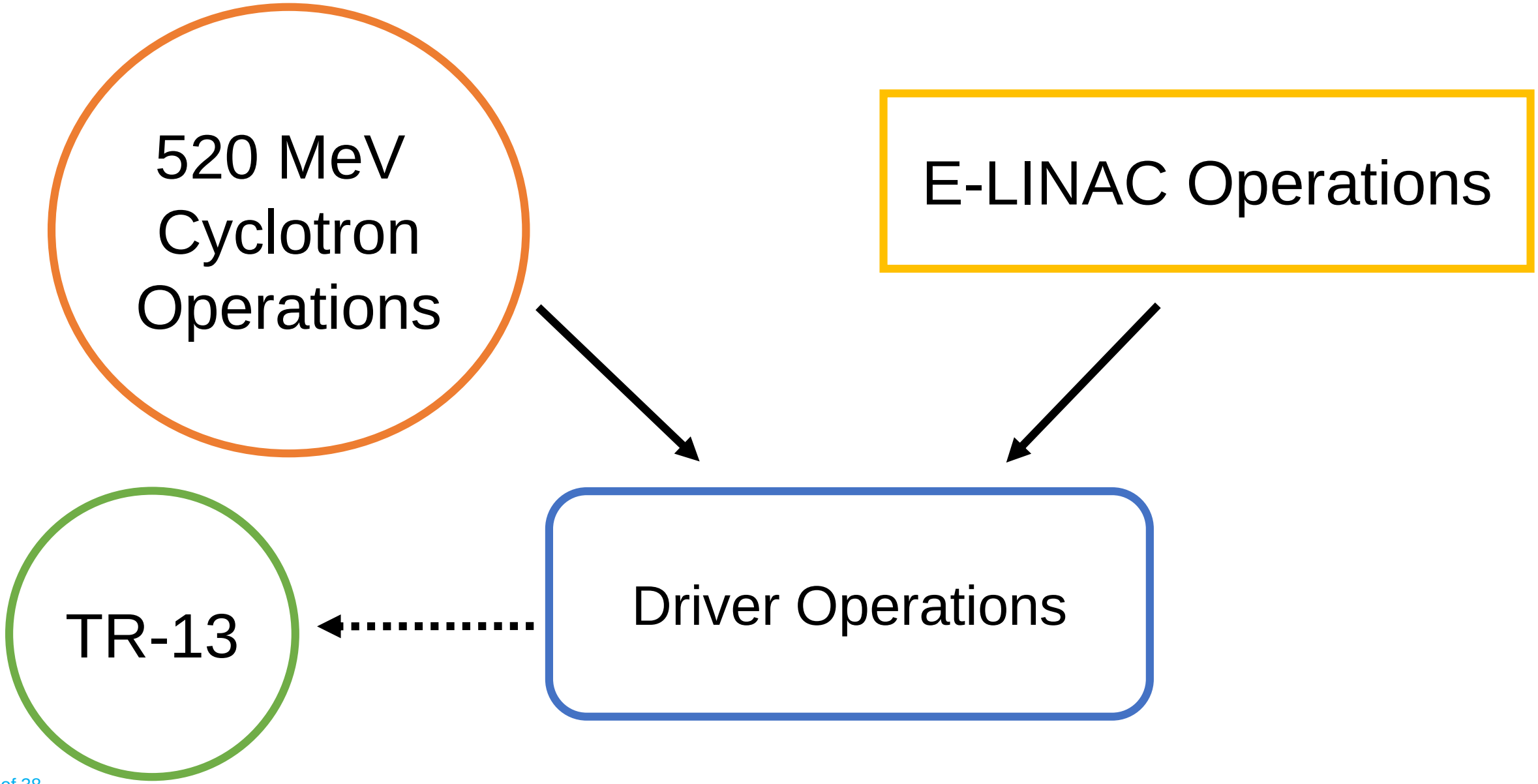
- 520 MeV Cyclotron
  - simultaneous p+ extraction
  - 3 primary beamlines & 1 in future
  - up to 5 experiments
- ISAC I & II
  - rare isotope production
  - up to 2 experiments
- TR-13 13 MeV cyclotron
  - medical isotope production
- ARIEL
  - 10 mA 30 MeV E-LINAC
  - RIB Production

Discovery, accelerated

WAO 2016 Shanghai: The Plan



The Plan: An update

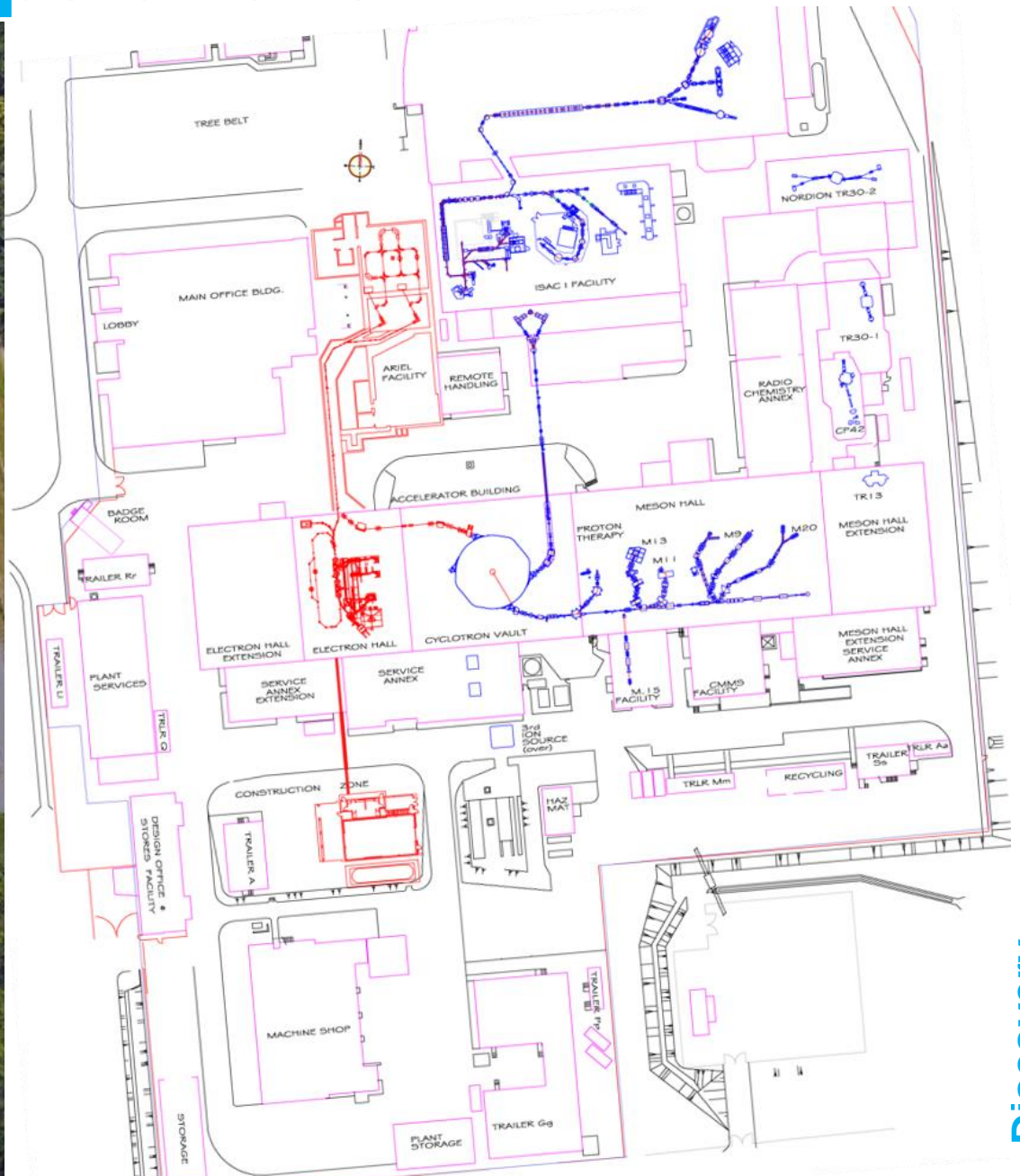


Is this a big change?

520 MeV Cyclotron	E-LINAC
Main Accelerator Building	Main Accelerator Building
beam driver	beam driver
shared systems: cooling water, compressed air, oxygen deficiency monitoring	
H^- -> protons	electrons
isochronous cyclotron + beamlines	e-gun & beamline, 3 SRF cavities
4 beams	1 beam
Central Control System (CCS)	EPICS Control System
44 years of operation	commissioning ~ 3 years
operators since the beginning (47 yrs)	1 commissioning operator (7 yrs, RIB)
established responsibilities & hierarchy	N/A

TRIUMF

Accelerator Operations



Discovery, accelerated

Is this a big change?

520 MeV Cyclotron	E-LINAC
Main Accelerator Building	Main Accelerator Building
beam driver	beam driver
shared systems: cooling water, compressed air, oxygen deficiency monitoring	
H^- -> protons	electrons
isochronous cyclotron + beamlines	e-gun & beamline, 3 SRF cavities
4 beams	1 beam
Central Control System (CCS)	EPICS Control System
44 years of operation	commissioning ~ 3 years
operators since the beginning (47 yrs)	1 commissioning operator (7 yrs, RIB)
established responsibilities & hierarchy	N/A

Initial reaction

Resistance in the beginning:

- "It will never work"
- Management doesn't understand our job
- work load is already heavy
- loss of expertise
- beam delivery will suffer
- side projects will suffer

But also...

- new accelerators prolong careers

Training began as an “as needed, when convenient” exercise.

Cross training:
ARIEL converter target testing

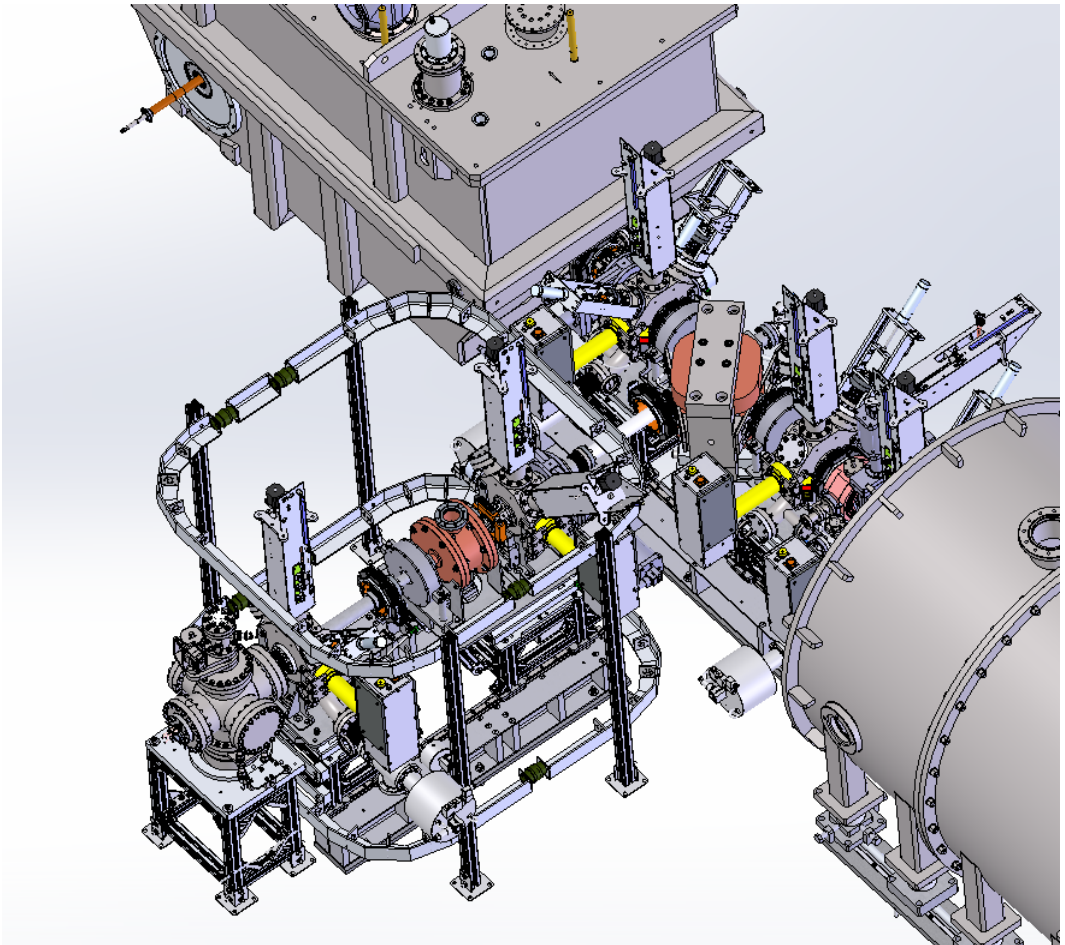
E-LINAC electrons produce radioactive ion beams via photo-fission.

- converter target converts electrons to photons

Converter test stand (CTS)

- converter target design and materials testing
- 300 keV electrons from e-gun
- low power testing
  - up to 1.6 mA, 480 W
- deadline to complete target testing

24 hr operation needed.
Training expedited.



Cross training challenges

"Learning is hard."

training occurring during commissioning = frustrating

- e-gun not ready for production mode
  - operators used to a fully functioning, well refined accelerator
- equipment failures; system experts still learning
  - training downtime
- machine instabilities not understood
  - training downtime

Cross training challenges

"Learning is hard."

- maintenance days/meetings not coordinated with training days
  - training downtime
  - *solution:* change maintenance day meeting to day before maintenance day so operators could plan whether operations coverage is needed

- training plan and procedures development in progress
  - operator training plan not fully developed for some
  - commissioning team training used originally
  - difficult balance between training and commissioning

Cross training struggles: three examples

1. training before machine production system
   - operator errors
2. constant changes to controls that are unfamiliar
   - difficult to keep up
3. disruption to schedules and shift-rotations
   - grumpy operators

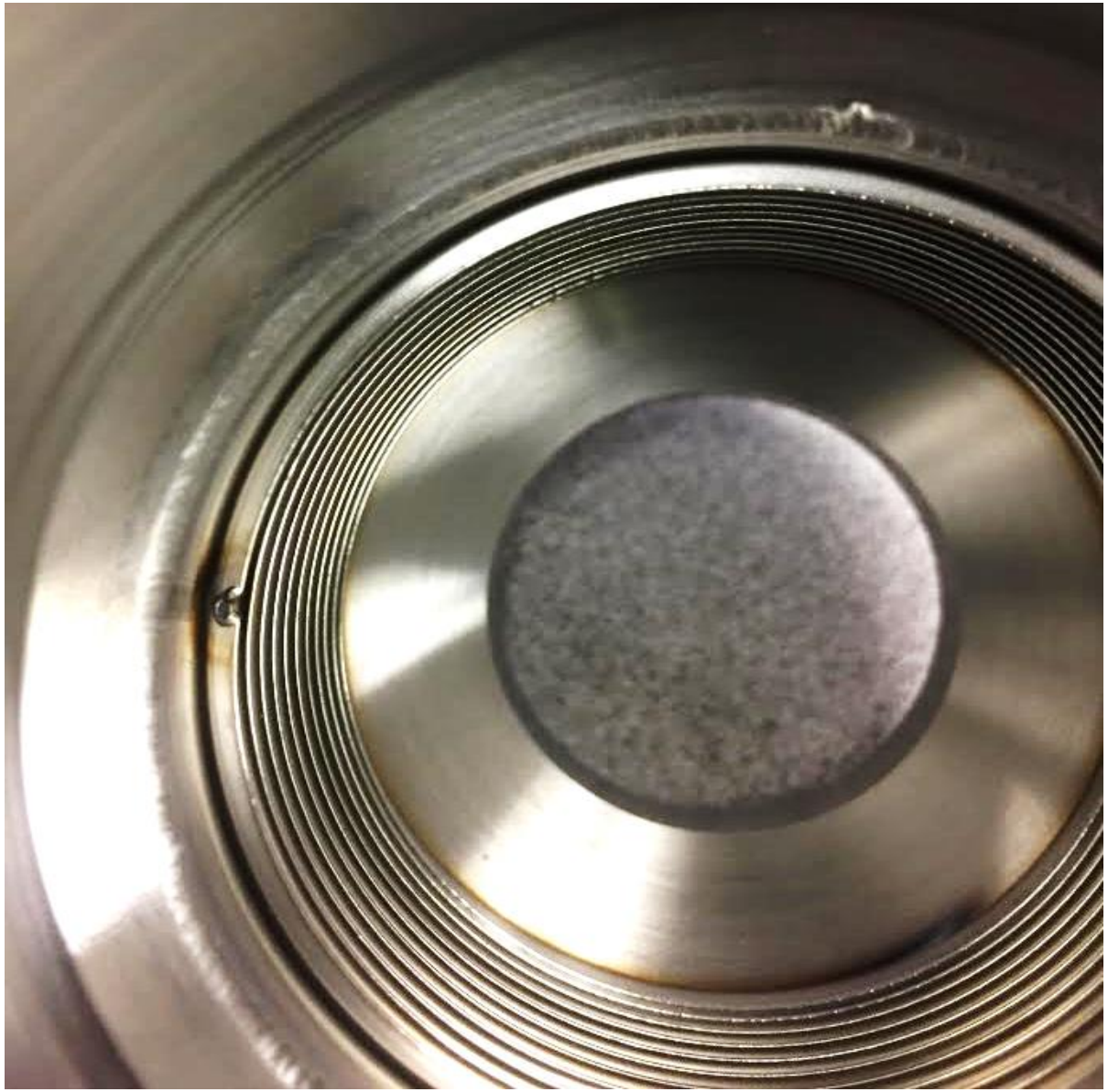
Example 1: Machine protection

Beam delivery to CTS.
Beam path includes a bend.

No machine protection.

Beam was on while the
e-gun 300 kV bias
was being ramped up.

Example 1: Machine protection



Delay of CTS tests.
Delay of training.

BUT!

Implementation of machine protection system.

Example 2: Controls

"Our way is better."

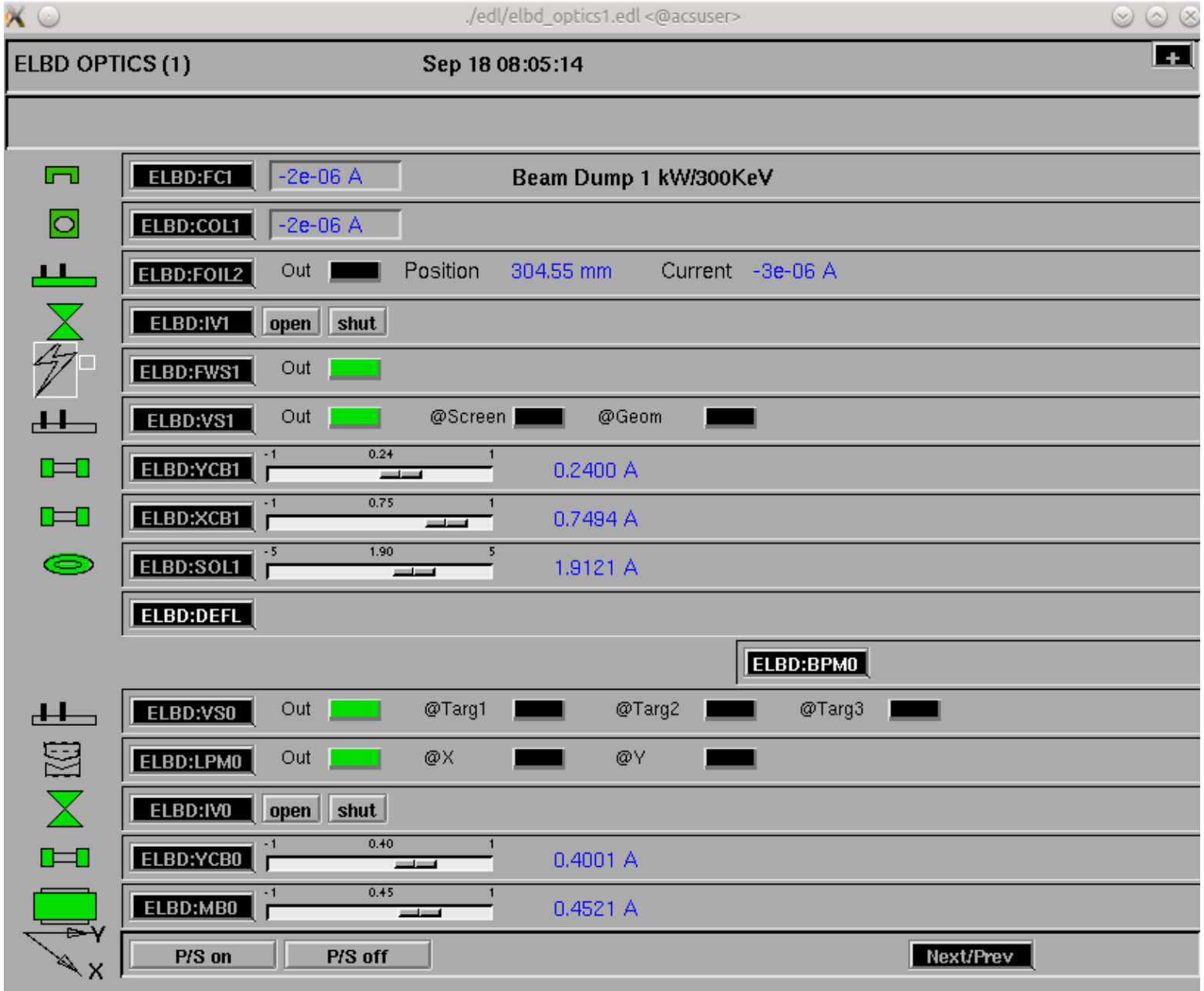
Two different control systems

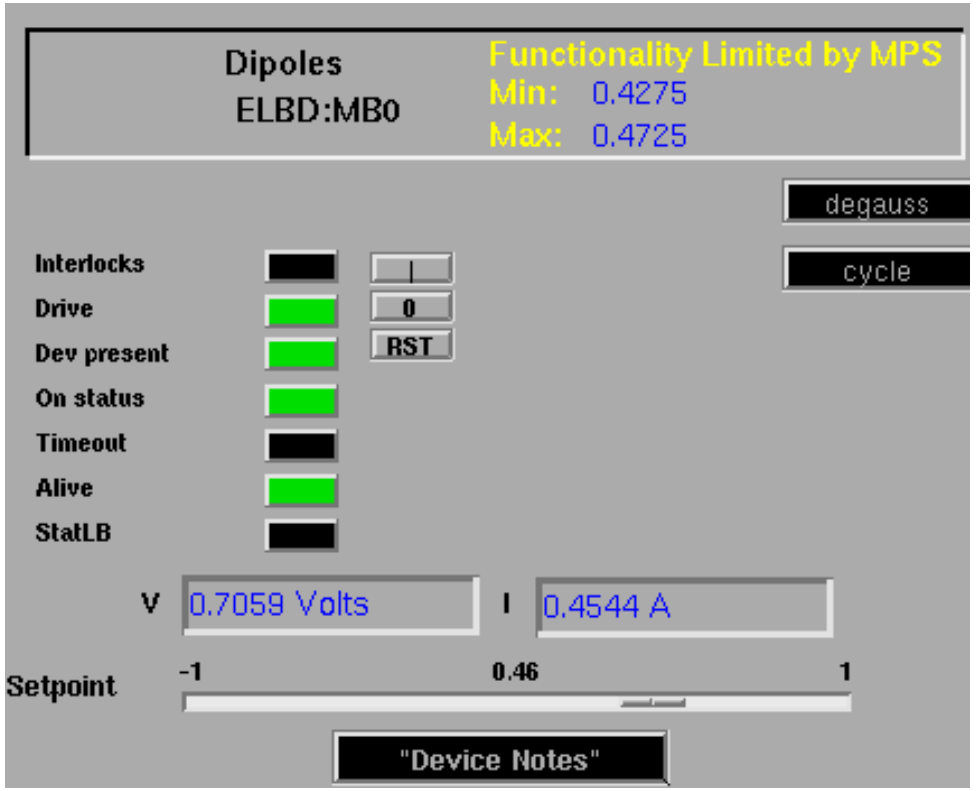
- Central Control System (CCS)
- EPICS

Differences:

- alarm handling
- interlock defeat
- colour schemes
- device name conventions
- devices organization
- signal display
- data handling (saving, retrieving)
- interaction with controls personnel

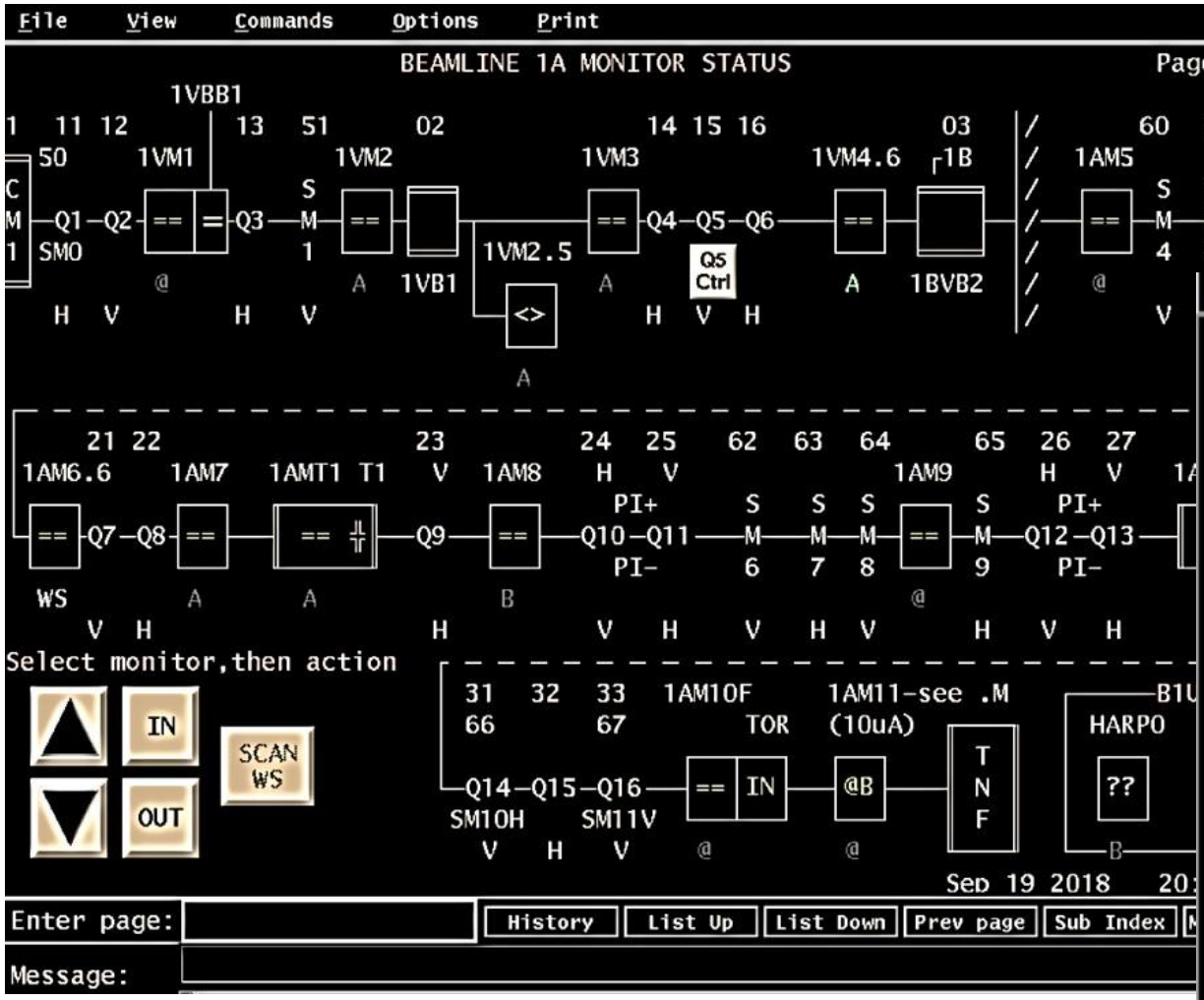
Beamline controls: EPICS

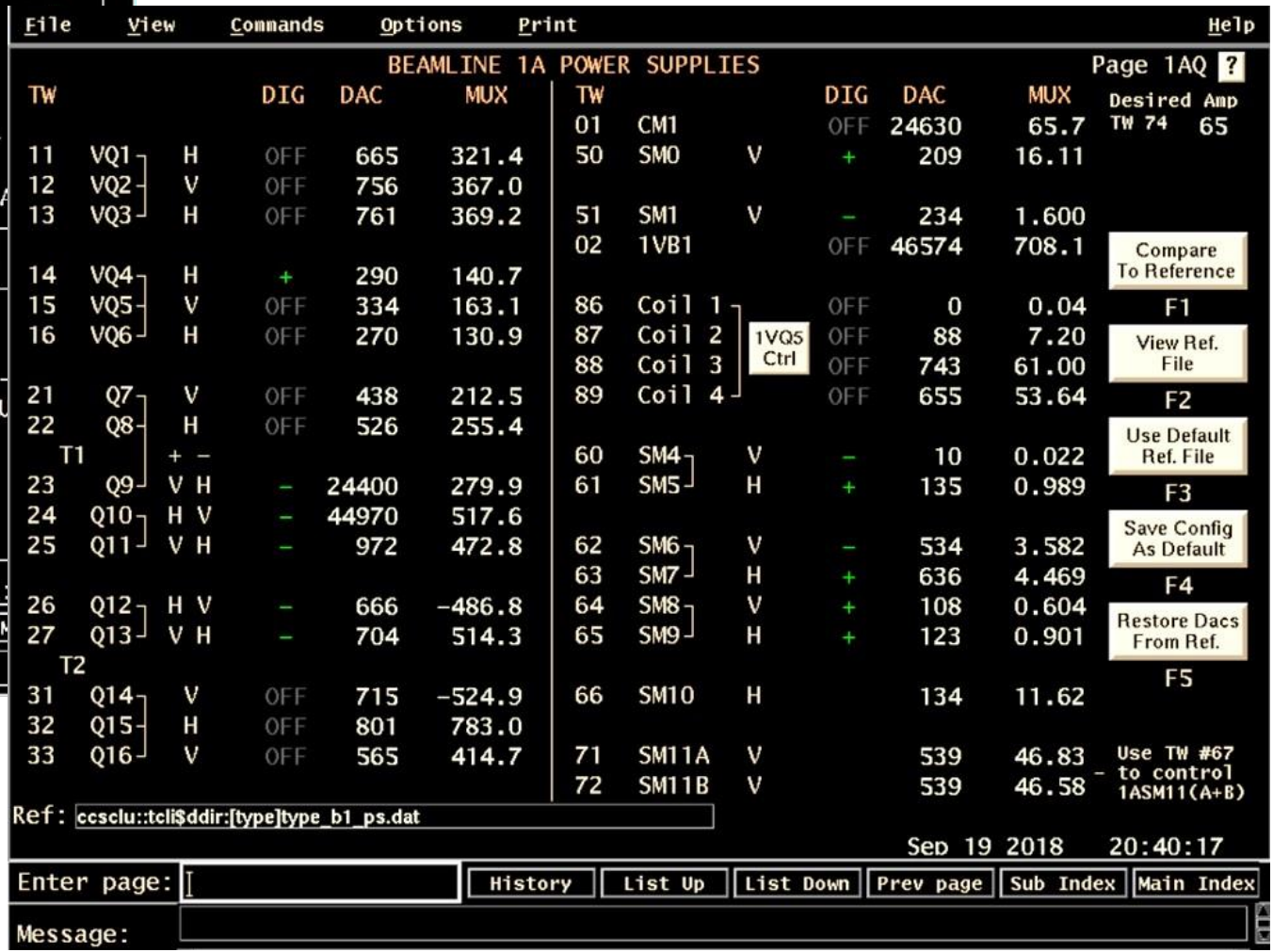




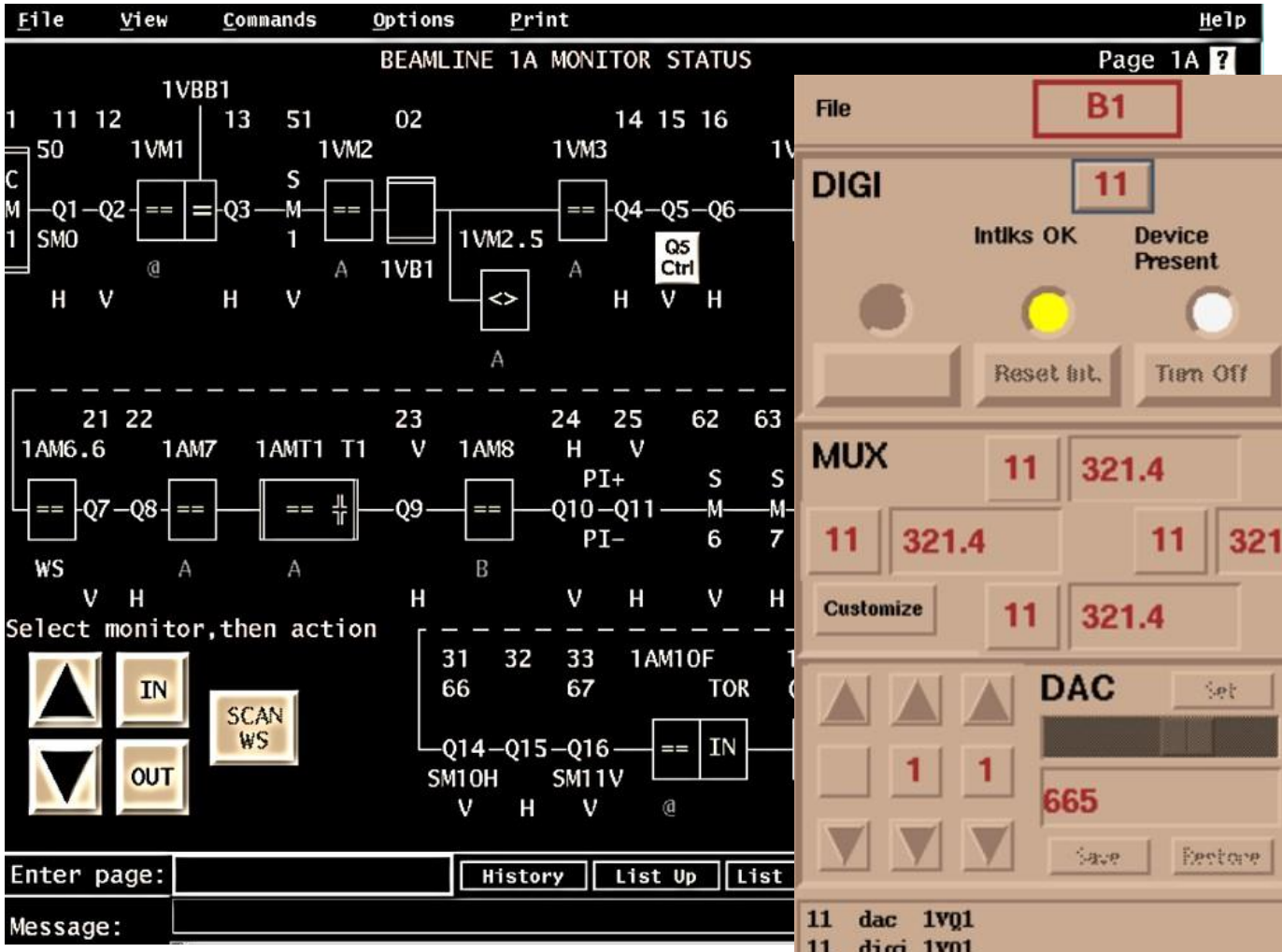
Discovery, accelerated

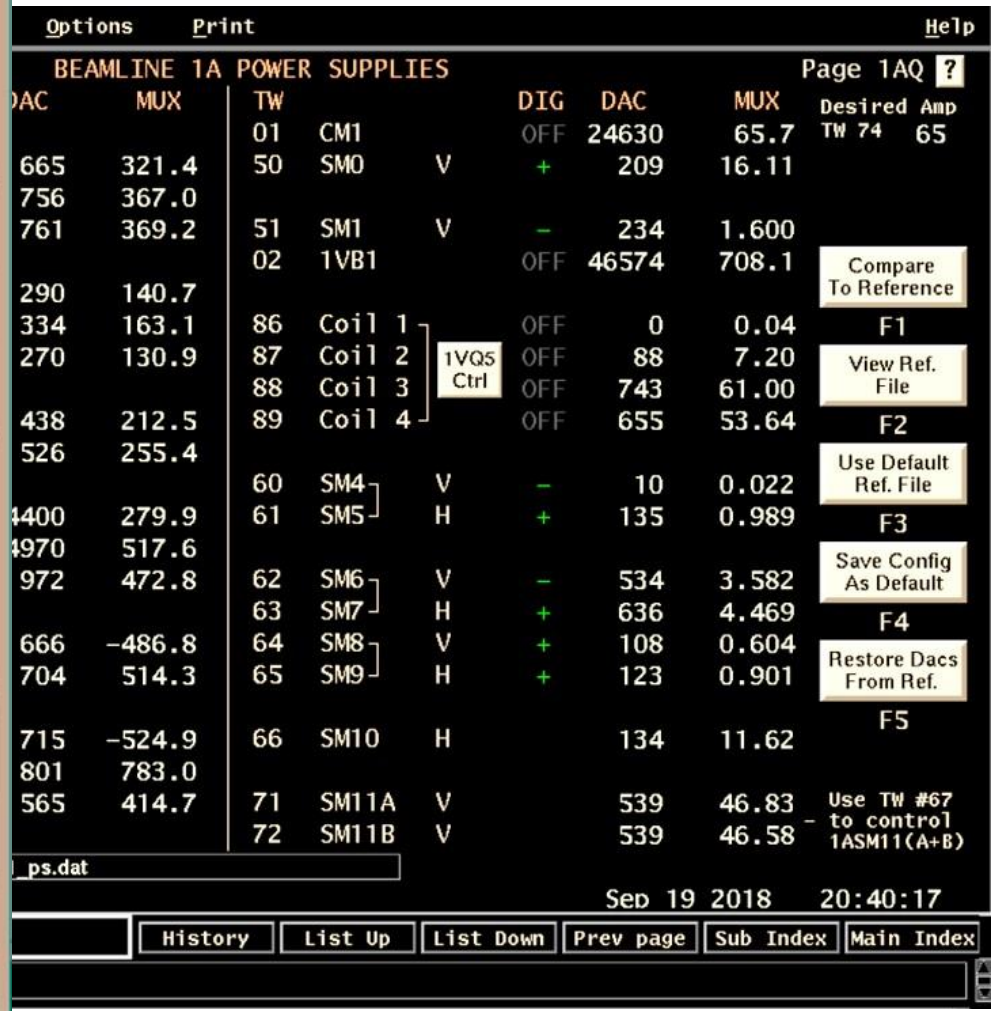
Beamline controls: CCS





Beamline controls: CCS





Example 2: Controls

Coping:

- suggestions and wish list

Benefit:

- new cyclotron controls are EPICS
- easier transition

Discovery, accelerated

Example 3: Scheduling

Help was needed with CTS runs and vacation coverage.

- only some operators trained
- different levels of training and knowledge

Summertime vacation = Operations very short staffed.

- quick shift turn-around
- little choice or warning re: schedule changes

Shift schedule changed from 24 hr rotating to 12 hr.

- 7:00-15:00 / 11:00-19:00
- no shift differential compensation for work outside core hours

Life-work balance disrupted; Morale is very low.

Example 3: Scheduling

Result: Changes to E-LINAC scheduling.

- clarification that is ok to say no
- less shift-shuffling
- E-LINAC downtime due to no operations coverage ok

Then, 24 hr operation started. Concerns about safety:

- operating from two different locations
- staffing requirements for cyclotron running/emergency response
- no E-LINAC safety system in cyclotron control room

Result: Control Room Renovation

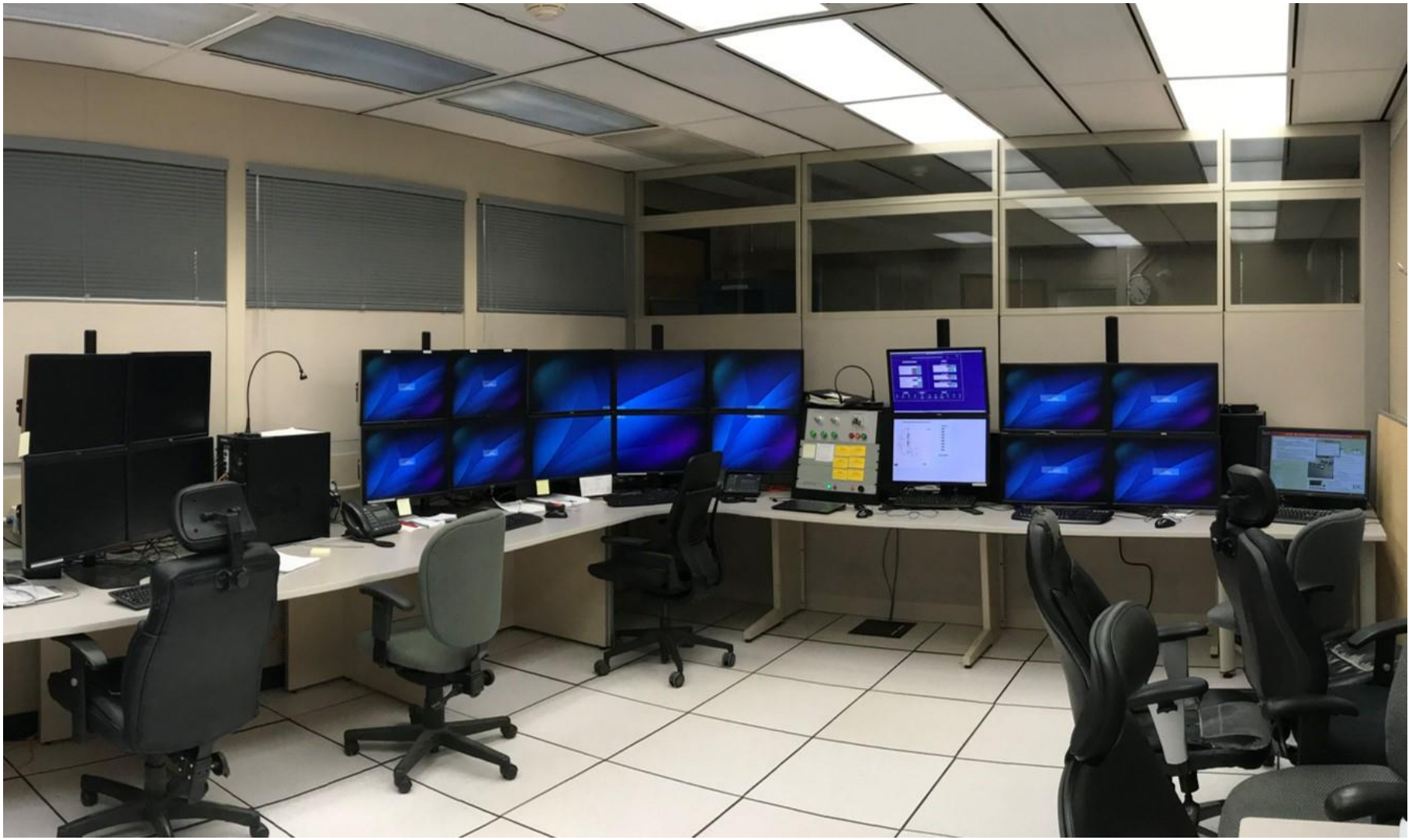
Realization… change will be better.

The sooner the two control rooms are merged, the better for all!

Main Control Room Before

out of screen or desktop real estate

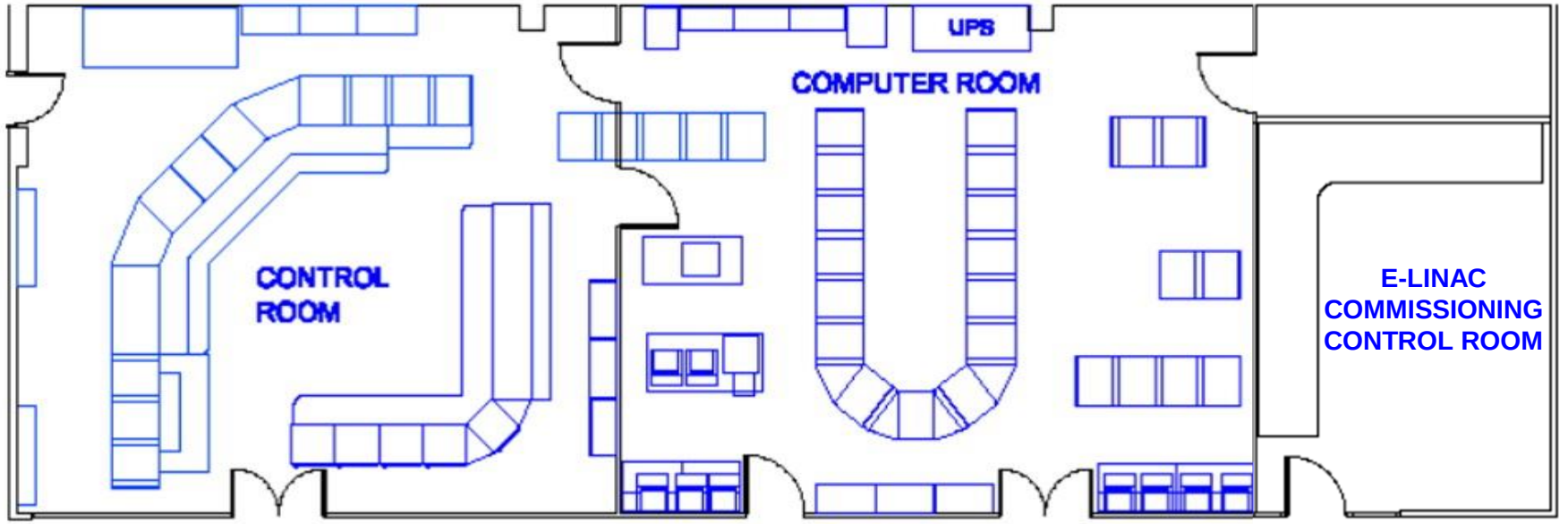
Result: Control Room Renovation



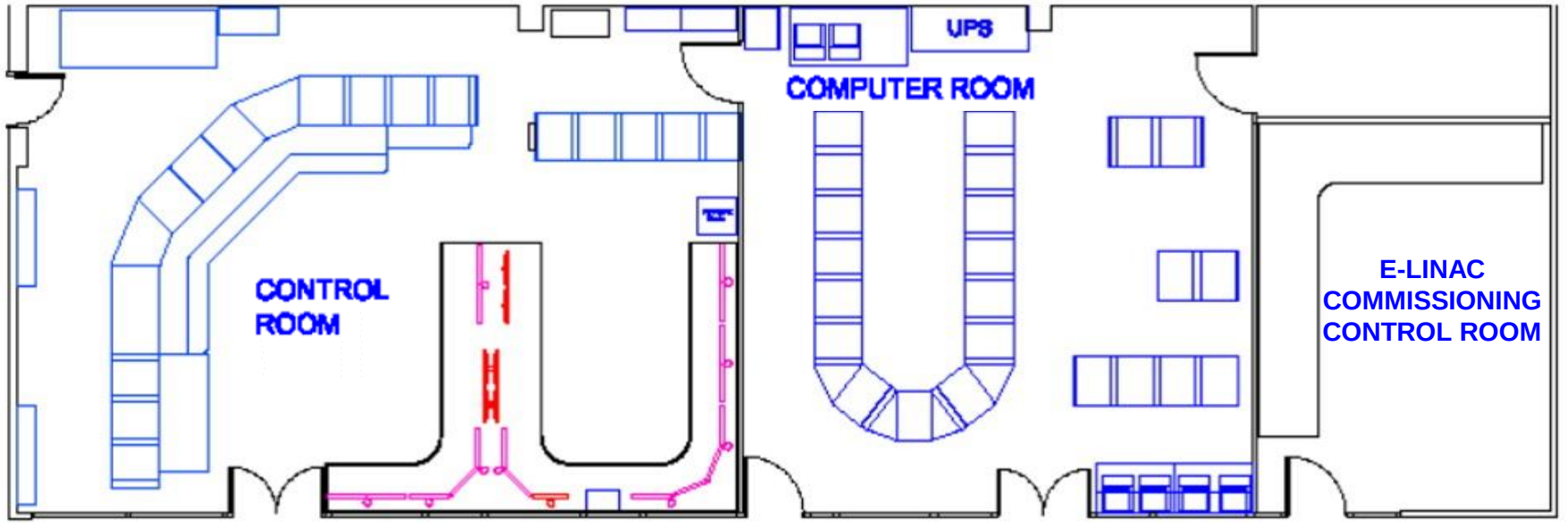
E-LINAC commissioning control room

- 4 console computers
  - 4-6 monitors
- safety system
  - hardwired control box
  - 2 monitors

Result: Control Room Renovation



BEFORE

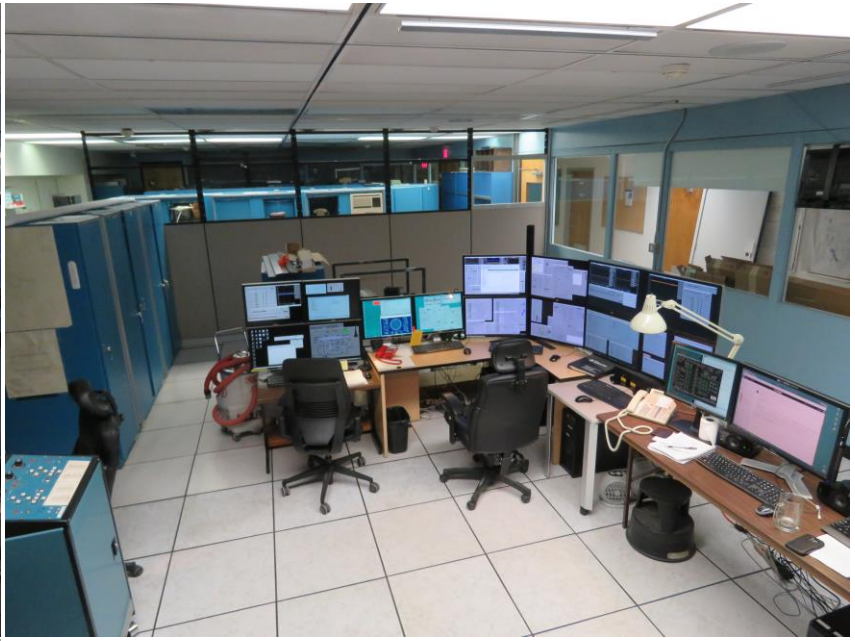
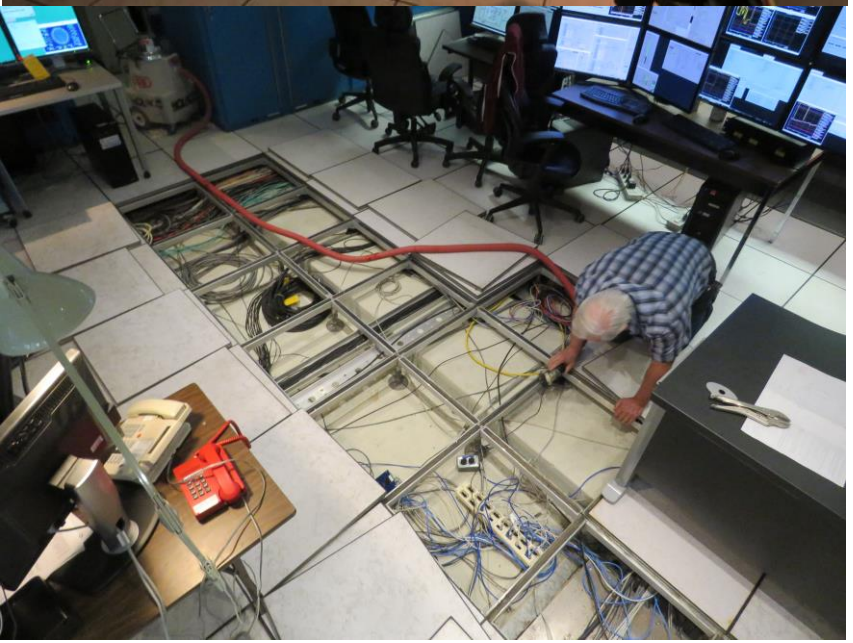
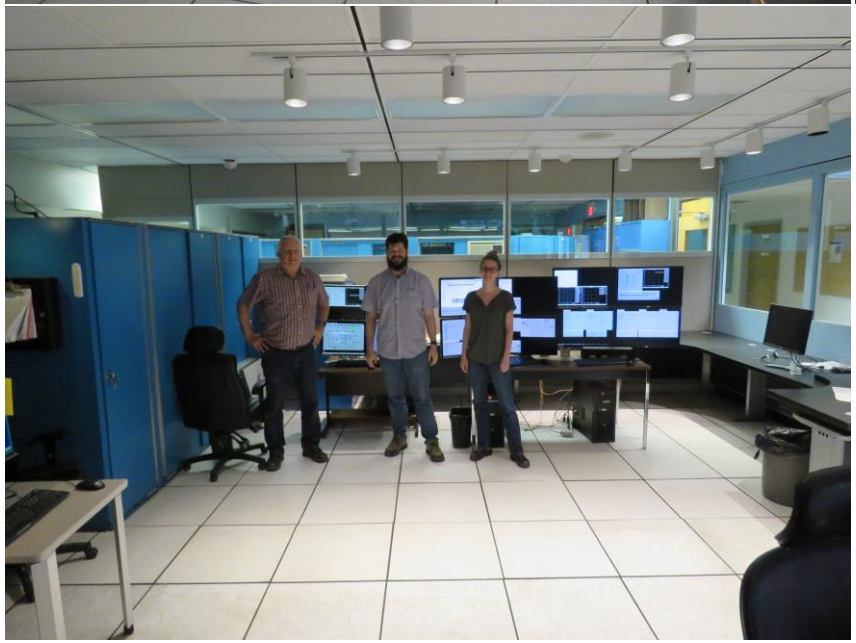


AFTER

Discovery, accelerated

Result: Control Room Renovation



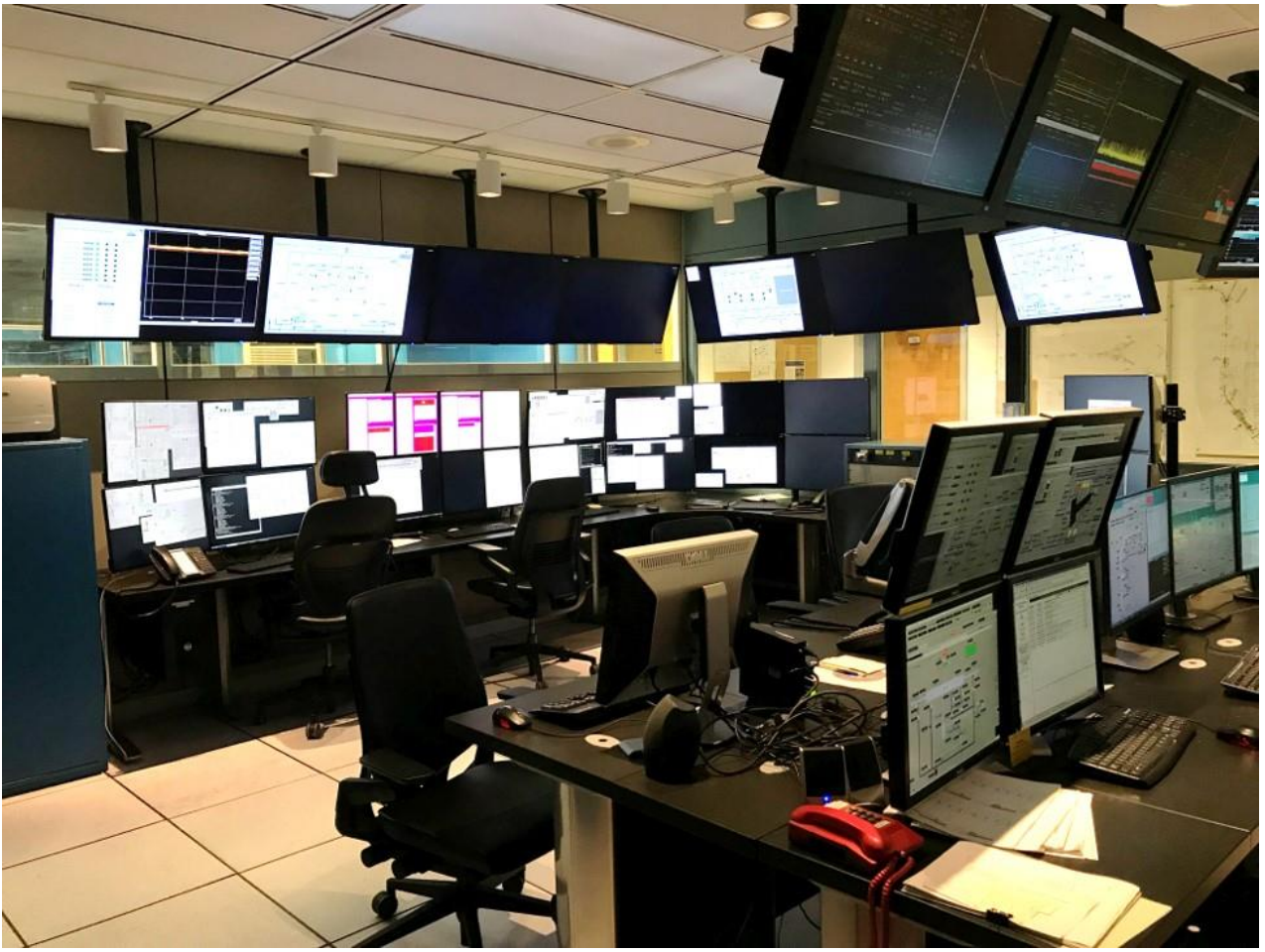
Ownership
- design
- labour

All operators

Shutdown

Discovery, accelerated

Result: Control Room Renovation



Result

Able to monitor both accelerators at one time.

Commissioning control room untouched.

Result: Control Room Renovation

Result

Safety review and procedure for 300 keV energy runs.
Temporary auxiliary E-LINAC safety system installed.

Positives from the cross training process

We did it!

- Low energy training successful. Of 16 operators:
  - not trained: 5
    - 4 shift supervisors, retirement in the next ~5 years
    - 1 new hire (spring 2018)
  - 1 cyclotron operator involved with high energy commissioning
- Ran E-LINAC at low energy in same room as cyclotron.
- Completed of converter target testing on schedule.

Positives from the cross training process

- Control room construction (almost) complete.
- Preparing for cyclotron controls conversion to EPICS in the future.
- Comradery!
  - supporting each other
  - finding solutions together

All and all for the betterment of TRIUMF!

Where are we now?

Driver Control Room - move in progress.

Operator concerns:

- loss of identity: Main Control Room? Driver Control Room?
- change in work environment
- how will the E-LINAC responsibilities integrate into the current MCR hierarchy?

Shutdown 2019 to-do list:

- finish upgrading consoles, organizing control room space
- move of safety system controls from ELCR to MCR
- human factors plan and analysis
- establish procedures for how to operate two accelerators in one room

The Future

Training and commissioning to come:

- E-LINAC high energy beam delivery to target stations
- MCR training for E-LINAC commissioning operator
- combining training plans and procedures

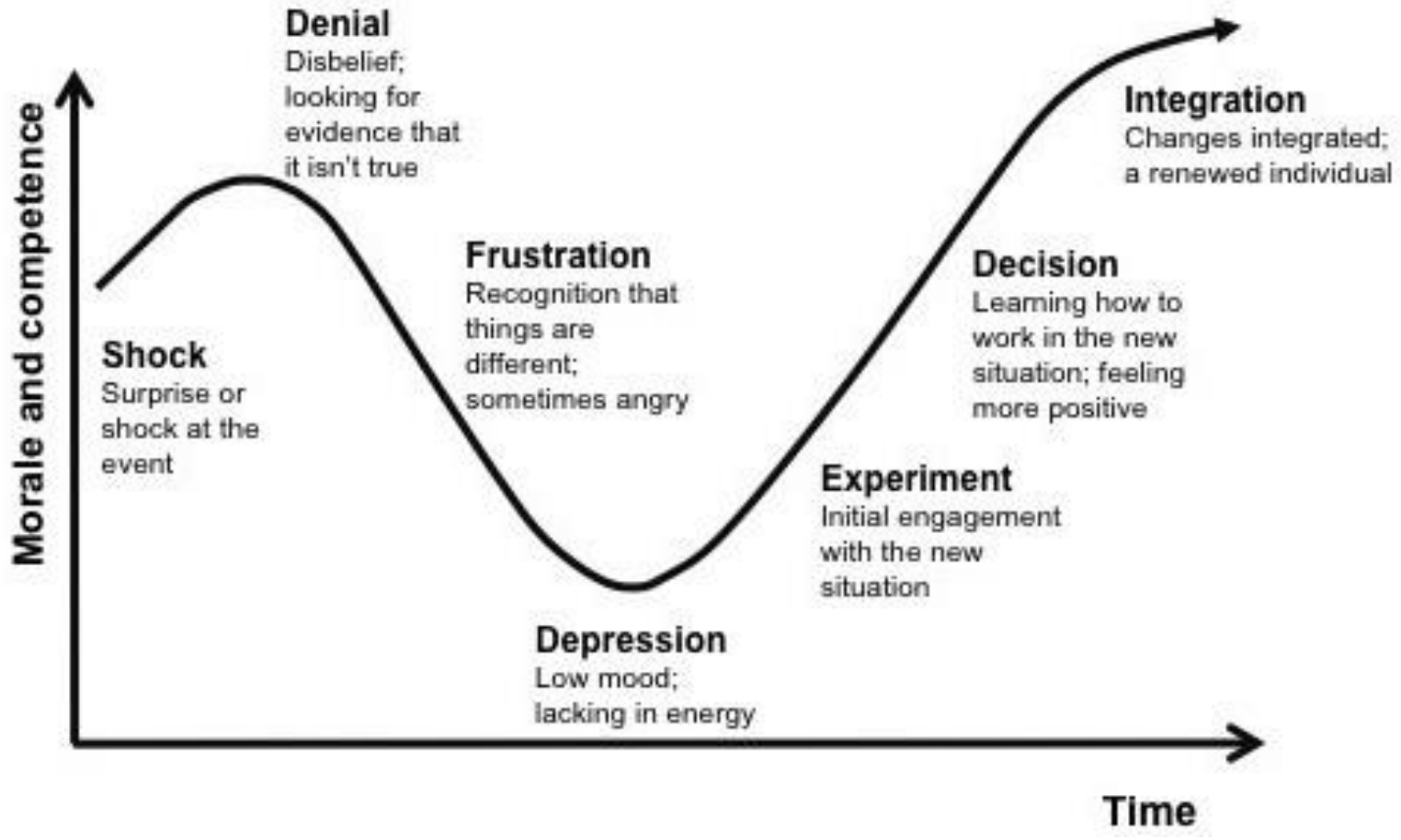
Longer term:

- proton & electron beam delivery for experimental programs
- another accelerator: TR-24 medical isotope production cyclotron

Even longer term:

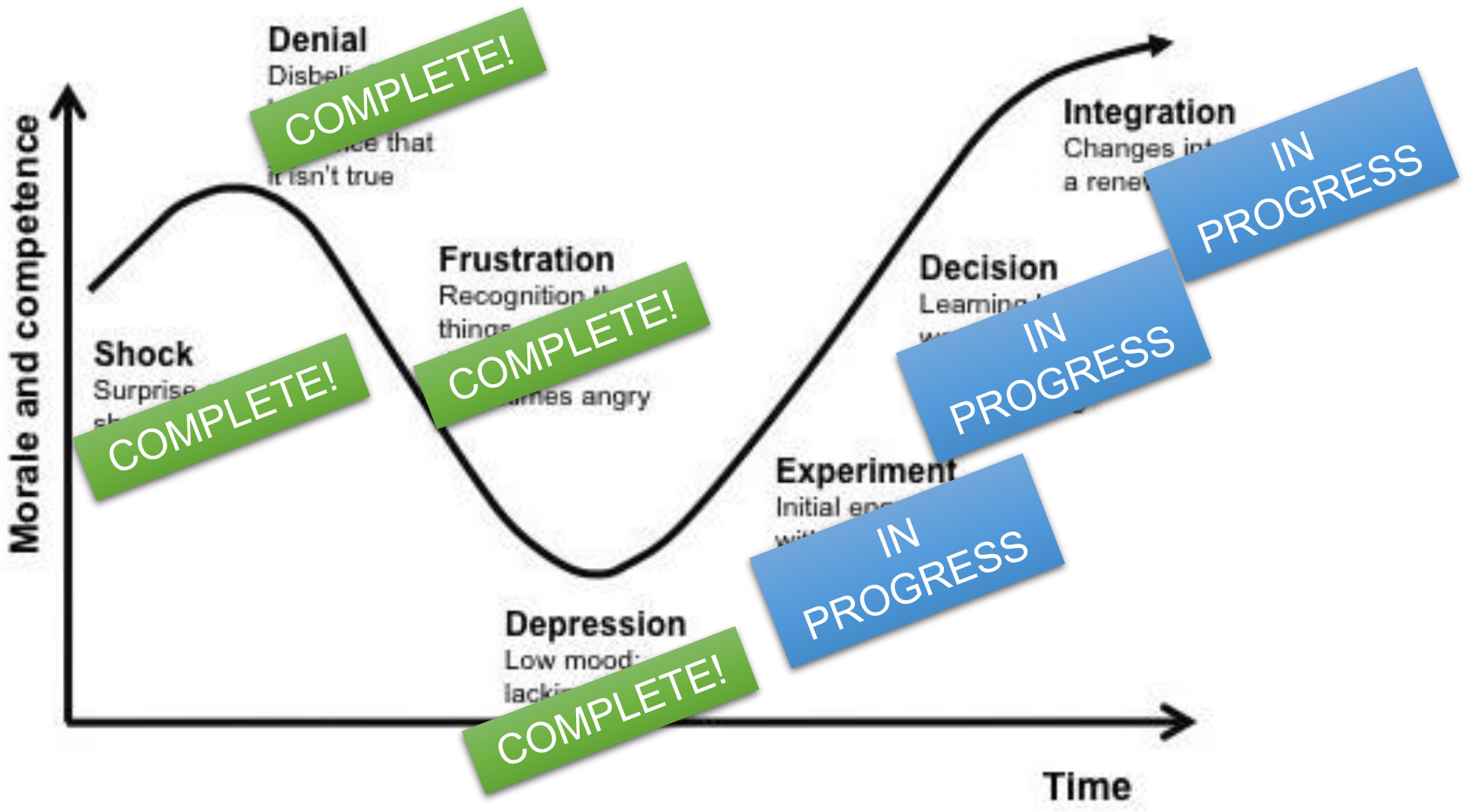
- all Operations Groups into one room

Closing thoughts



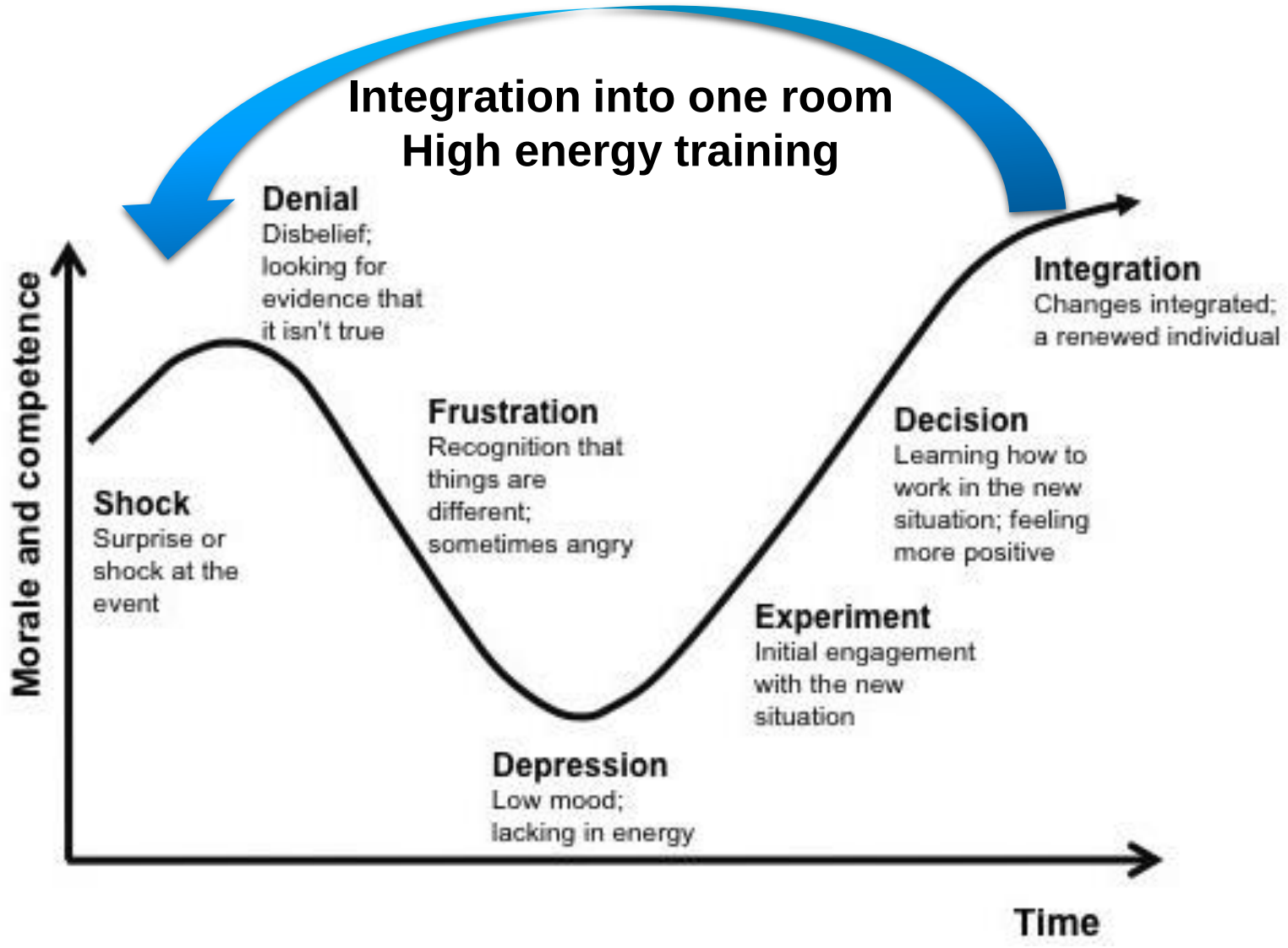
Elisabeth Kubler-Ross model – Five Stages of Grief

Closing thoughts



It’s only up from here. Or is it?

Closing thoughts



It is human nature to resist change.

Suggestions from Operators

When is the best time to bring operators into the commissioning process?

- more than one operator from the beginning(3)
  - spread out expertise, workload, overtime, vacation

How can we make the commissioning or training process faster?

- support/implement operators' suggestions from the beginning
  - layout and design of controls
  - makes training and operating the accelerator easier
  - saves time and people resources

Suggestions from Operators

When is the best time to train the rest of the operators?

- further along into commissioning
- training plans and procedures established
- machine protection in place
- training schedule pre-established
  - plan training schedule around maintenance days
- dedicated training time
  - no back and forth between control rooms

Is there a way to quicken understanding and buy-in of a big change?

Thank you
Merci

Kathleen Genge genge@triumf.ca

Discovery, accelerated