# PXD Module Recovery

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PXD Workshop at DESY,
September 23/24, 2019

# As-is and Boundary Conditions

### Goals of this discussion

- simplify recovery of a small number of failed modules
- ideally by global shifter
- define the recovery procedure
- define our requests for the changes to the HV Control system

# As-is and Boundary Conditions
Definition of recovery process
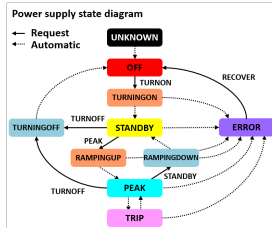
## Recovery

PEAK → ERROR → PEAK

## Allowed transition

The HV states are well defined and not all transitions are valid.

Most important for the *recovery* procedure is the PEAK state, where we are only allowed to go to TRIP and back to PEAK. ERROR does not allow a transition back to PEAK.

PEAK ⇔ TRIP

## PS state diagram



Power supply state diagram

←─ Request
←‒ Automatic

- **SHOULDER** state is omitted
  - No detector needs the state
- Intermediate state is defined
- **ERROR** state is introduced

Stable state:
- **UNKNOWN** : Not available
- **OFF** : ALL channels are turned off
  - *Allows normal beam injection*
- **STANDBY** : Voltages for Normal injection
  - *Allows normal beam injection*
- **PEAK** : Voltage for physics run
  - *Allows continuous beam injection*

Intermediate state : automatically shift
- **TURNINGON** : OFF => STANDBY
- **RAMPINGUP** : STANDBY => PEAK
- **RAMPINGDOWN** : PEAK => STANDBY
- **TRUNINGOFF** : => OFF

Error state:
- **TRIP** : automatic recover by detector
- **ERROR** : unrecoverable problems

# Error states for a PXD module

## ERROR state

In the current version of the DHH/PS Sequence the following scenarios can cause an ERROR state for a single module:

- Interlock triggered
- OVP triggered
- Current mismatch

## UNKOWN state

In case the IOC lost connection or crashed, this will result in UNKNOWN state to report different behavior. This should be handled as ERROR on the top PXD level.

## TRIP state

The TRIP state is not used.

## Discussion
### The TRIP state

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### Basic idea:

Un-follow the *failed* modules and recover them.
We cannot go to ERROR in the *global* state, since there is no direct way back to PEAK!

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### Proposal of the global PXD TRIP state

PXD can define its own TRIP state by internal definition?

     TRIP  1-2 module go into an ERROR state
            $\Rightarrow$ Belle 2 shifter presses the *RECOVER* button!

  ERROR  Multiple modules reach ERROR
            $\Rightarrow$ PXD expert should look into it!

$\rightarrow$ Both states inhibit the continuous and normal injection!

## Discussion
Module recovery for PXD

Since just ramping is not enough for PXD:

- What does it mean to recover a PXD module?
  (TRIP state should not force a run stop so far)
- What is necessary?
    - Ramping to STANDBY and PEAK?
    - New pedestals?
    - Verify voltages and currents?
- How to handle a "*stuck*" PS sequence due to current limit during ramping? Timeout?

## Discussion
Recovery proposal

**Recover from TRIP:**
The module stays in ERROR until RECOVER is pressed.

Things to be done on module side:

1. Bring module to OFF and reset OVP if necessary.
2. Ramp to STANDBY without pedestals from configDB
3. Upload latest pedestals during ramping to PEAK
   (Could be provided by the CalibrationIOC)
4. Upload STANDBY pedestals after reaching PEAK
   (All pixels masked for DAQ test runs)

## Discussion
Recovery proposal

**Recover from TRIP:**
The module stays in ERROR until RECOVER is pressed.

Things to be done on DAQ side:

1. Change the DHP mask until fully recovered
2. Do not stop the triggers for this DHE
   (The full DHE must not be masked! Otherwise the order within a single DHC changes and the occupancy calculation breaks.)

## Discussion
### Requested Changes

### Separate injection permit from reported HV state

- report state for injection
- report state for DAQ operation

*How to handle excluded modules?*