Data-Driven Campaign Management at the National Ignition Facility

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What do we mean by “Campaign Management” and “Data Driven”

- “Campaign Management” refers to the software, data, and workflows through which we setup, review, approve and export experiments on the NIF

- Campaign Management Suite applications include:
  - Campaign Management Tool: experiment setup editor
  - Parts and Lists Manager: db app to manage CMT setup options
  - Approval Manager: manages approval workflow of completed setups
  - Shot Setup Reports: formats experiment setup selections into reports for review

- Within the context of Campaign Management, an “experiment” is an XML document that captures all of the shot parameters that experimenters specify
  - A “data group” is the set of parameters for one diagnostic, one target system, etc.

- “Data Driven” describes an application architecture in which parameters that are key determinants of the logical flow are stored and managed independently of the application logic.
  - The interface(s) to the data separately support access by the application and also by maintainers of the system.

Why use data-driven architectures?

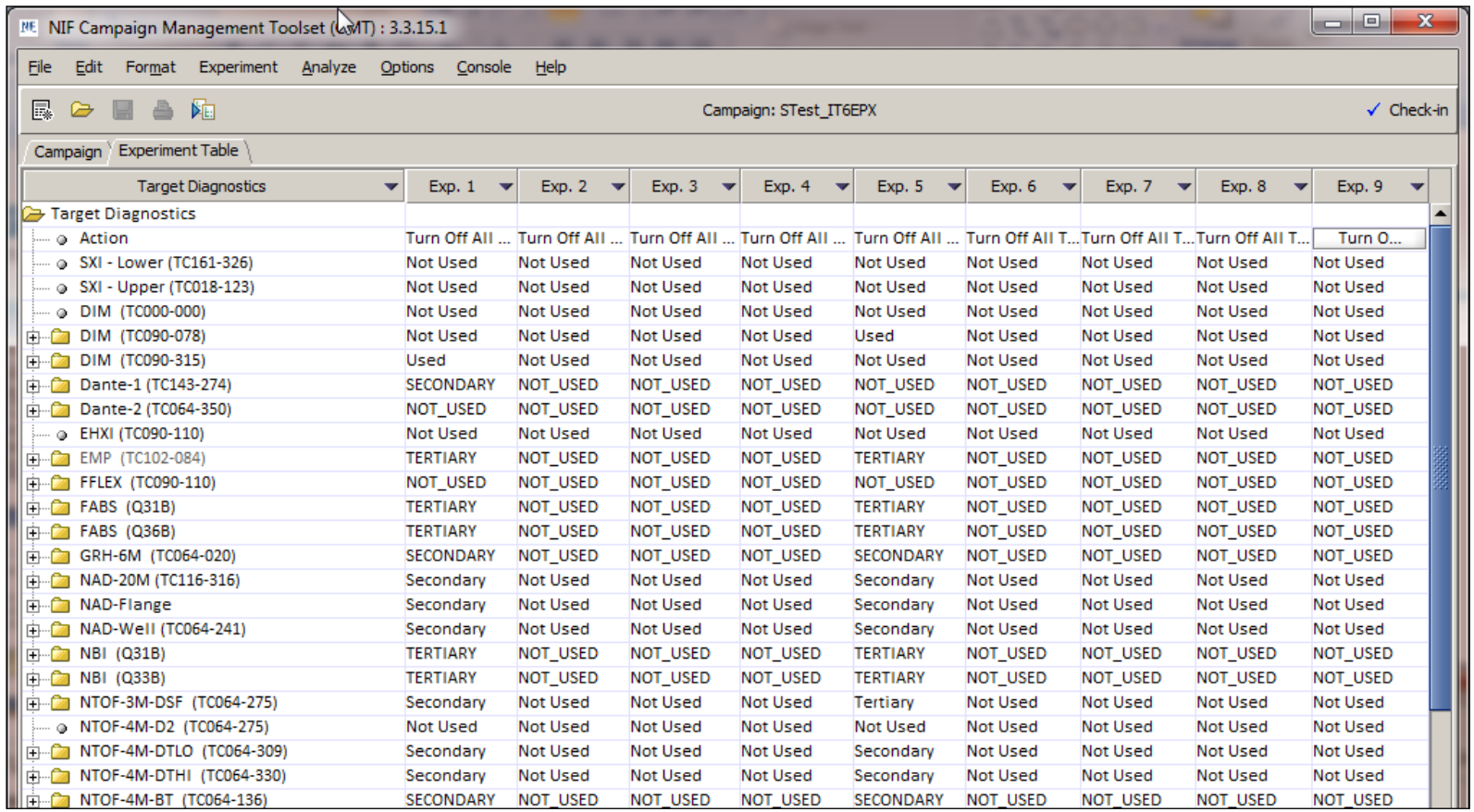
- **Change is constant – new diagnostics, updated diagnostics, new components, software feature updates**

- **Software development is expensive**
  - **Participation of multiple developers and full-time test engineer**
  - **Deployments needed to multiple development environments plus Production**
  - **Deployments to Prod interrupt production operations for several hours**

At the cost of some increase in software complexity, "data-driven" lets us replace software release cycles with much cheaper data deployments

Campaign Management Tool (CMT)

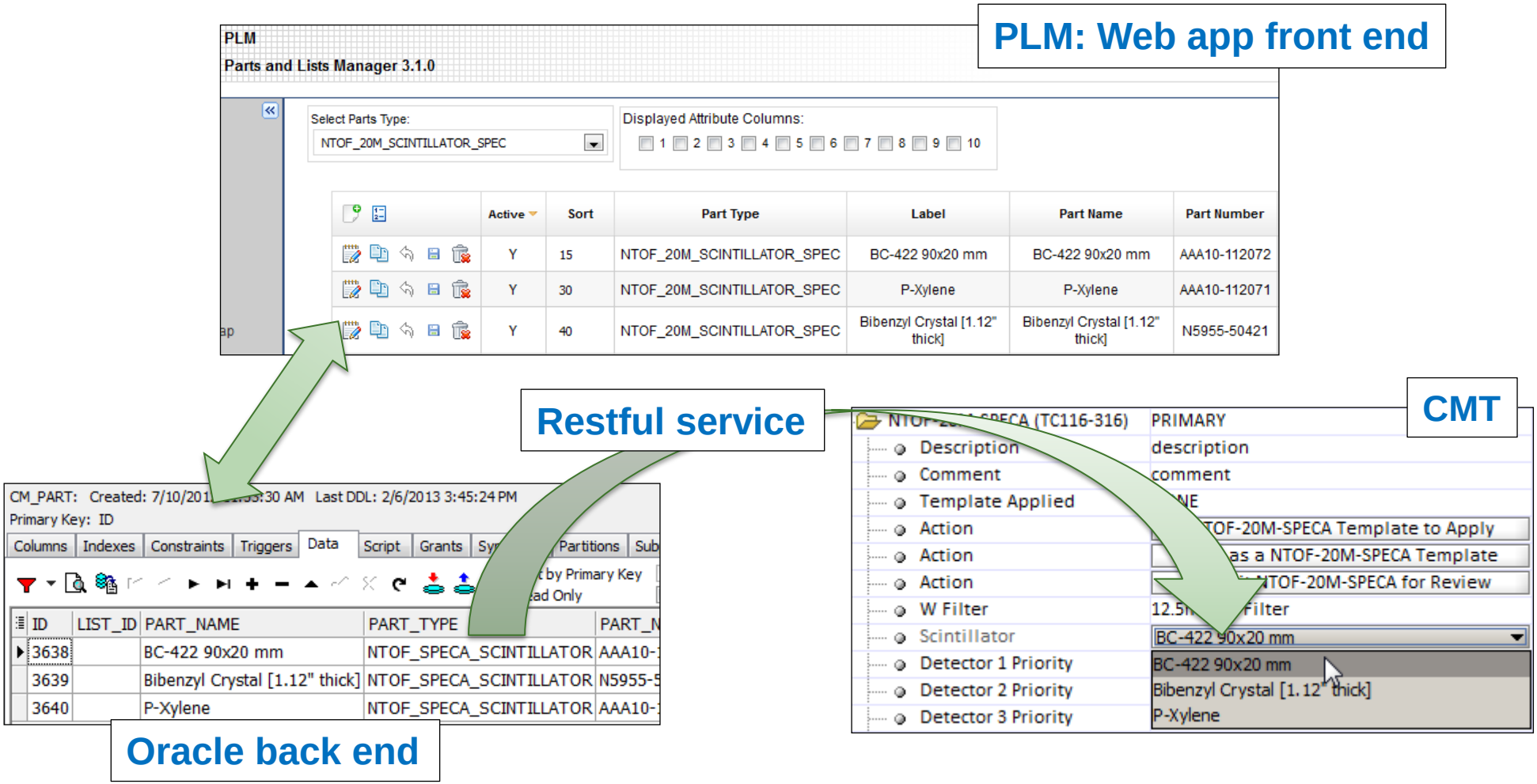
- **Spreadsheet-style experiment editor**
- **Sets pulse, energy, timing, pointing, and laser diagnostics configuration for 192-beam NIF laser , configurations for ~40 target chamber diagnostics, 2 target systems → ~20000 parameters managed**



Target Diagnostics	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6	Exp. 7	Exp. 8	Exp. 9
Target Diagnostics									
Action	Turn Off All ...	Turn Off All ...	Turn Off All ...	Turn Off All ...	Turn Off All ...	Turn Off All T...	Turn Off All T...	Turn Off All T...	Turn O...
SXI - Lower (TC161-326)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
SXI - Upper (TC018-123)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
DIM (TC000-000)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
DIM (TC090-078)	Not Used	Not Used	Not Used	Not Used	Used	Not Used	Not Used	Not Used	Not Used
DIM (TC090-315)	Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
Dante-1 (TC143-274)	SECONDARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED
Dante-2 (TC064-350)	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED
EHXI (TC090-110)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
EMP (TC102-084)	TERTIARY	NOT_USED	NOT_USED	NOT_USED	TERTIARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
FFLEX (TC090-110)	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED	NOT_USED
FABS (Q31B)	TERTIARY	NOT_USED	NOT_USED	NOT_USED	TERTIARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
FABS (Q36B)	TERTIARY	NOT_USED	NOT_USED	NOT_USED	TERTIARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
GRH-6M (TC064-020)	SECONDARY	NOT_USED	NOT_USED	NOT_USED	SECONDARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
NAD-20M (TC116-316)	Secondary	Not Used	Not Used	Not Used	Secondary	Not Used	Not Used	Not Used	Not Used
NAD-Flange	Secondary	Not Used	Not Used	Not Used	Secondary	Not Used	Not Used	Not Used	Not Used
NAD-Well (TC064-241)	Secondary	Not Used	Not Used	Not Used	Secondary	Not Used	Not Used	Not Used	Not Used
NBI (Q31B)	TERTIARY	NOT_USED	NOT_USED	NOT_USED	TERTIARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
NBI (Q33B)	TERTIARY	NOT_USED	NOT_USED	NOT_USED	TERTIARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED
NTOF-3M-DSF (TC064-275)	Secondary	Not Used	Not Used	Not Used	Tertiary	Not Used	Not Used	Not Used	Not Used
NTOF-4M-D2 (TC064-275)	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
NTOF-4M-DTLO (TC064-309)	Secondary	Not Used	Not Used	Not Used	Secondary	Not Used	Not Used	Not Used	Not Used
NTOF-4M-DTHI (TC064-330)	Secondary	Not Used	Not Used	Not Used	Secondary	Not Used	Not Used	Not Used	Not Used
NTOF-4M-BT (TC064-136)	SECONDARY	NOT_USED	NOT_USED	NOT_USED	SECONDARY	NOT_USED	NOT_USED	NOT_USED	NOT_USED

Parts and Lists Manager (PLM) separates management of CMT setup options from CMT codebase

- Helps manage a major source of change – resources associated with target diagnostics such as filters, attenuators, detectors, cameras, delay lines, etc.
- With PLM, these changes can be performed when convenient, and asynchronously with respect to CMT code deployments

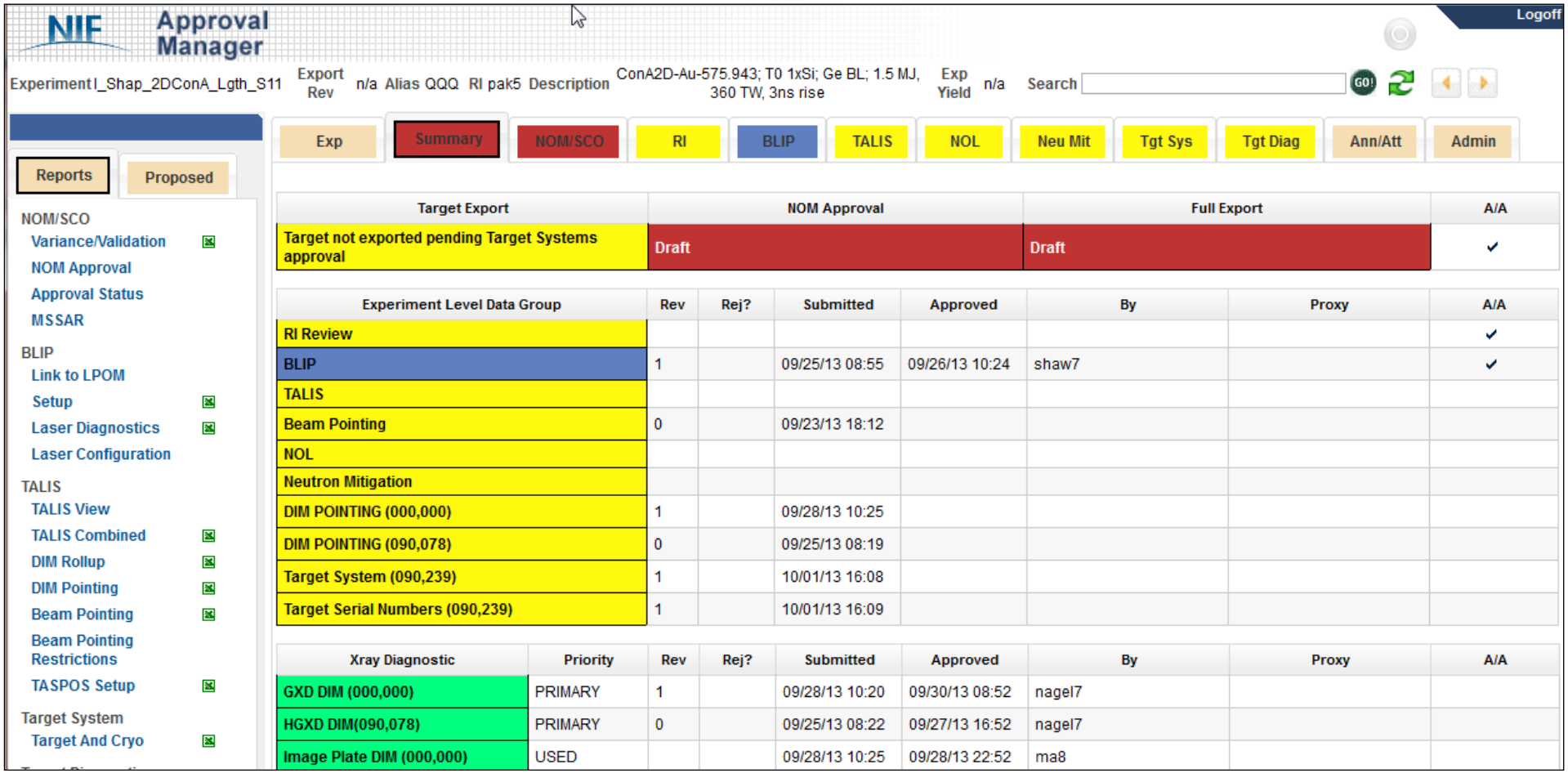


PLM flexibility carries a few challenges…

- Many part lists and the count is growing. List loads are a major component of CMT startup processing.
  - Recent re-design resulted in better than 2x speedup but this issue won't go away…
- Stale data is created if a PLM entry is removed or modified after being selected in an experiment. This may cause validation errors & interrupt workflow on the experiment.
  - We've begun tracking all selections in experiments and know immediately which experiments become stale due to a change.
  - Future capabilities will include ability to push updates to CMT clients during editing sessions.
- With Production, Formal Test, Integration, and Development environments all managed separately, keeping data consistent is an ongoing nuisance.
  - Specially formatted Excel files read and written by PLM let us migrate arbitrary selections of table rows and columns between environments

Approval Manager

- **Manages workflow for review, approval, export of experiments**
- **Data-driven by design**
- **Since 2011 introduction, approval workflow has been revised, expanded, diversified to enhance support of production operations**



Approval Manager Lessons Learned: Data Group Dependencies

- **After splitting the experiment into "data groups" to enable parallel review of unrelated setups, it turned out that they weren't all unrelated**
  - **Solution: configurable data group dependencies + workflow logic that rescinds approval of dependent data groups if the independent parent data group loses its approval**
  - **A dependency template defines all possible dependencies; whenever an experiment is saved it's configuration is scanned to determine if any parent/child dependency pairs exist and instantiates them for that experiment**

Example of instantiated dependencies for an experiment

These are the existing dependencies for experiment I_Shap_2DConA_Lgth_S11
All possible OWNER and DEPENDENT data group pairs are defined in the Dependency Template.
If any of those pairs exist in the current experiment, dependencies are created.
When the OWNER data group is rejected, the DEPENDENT data group is un-approved

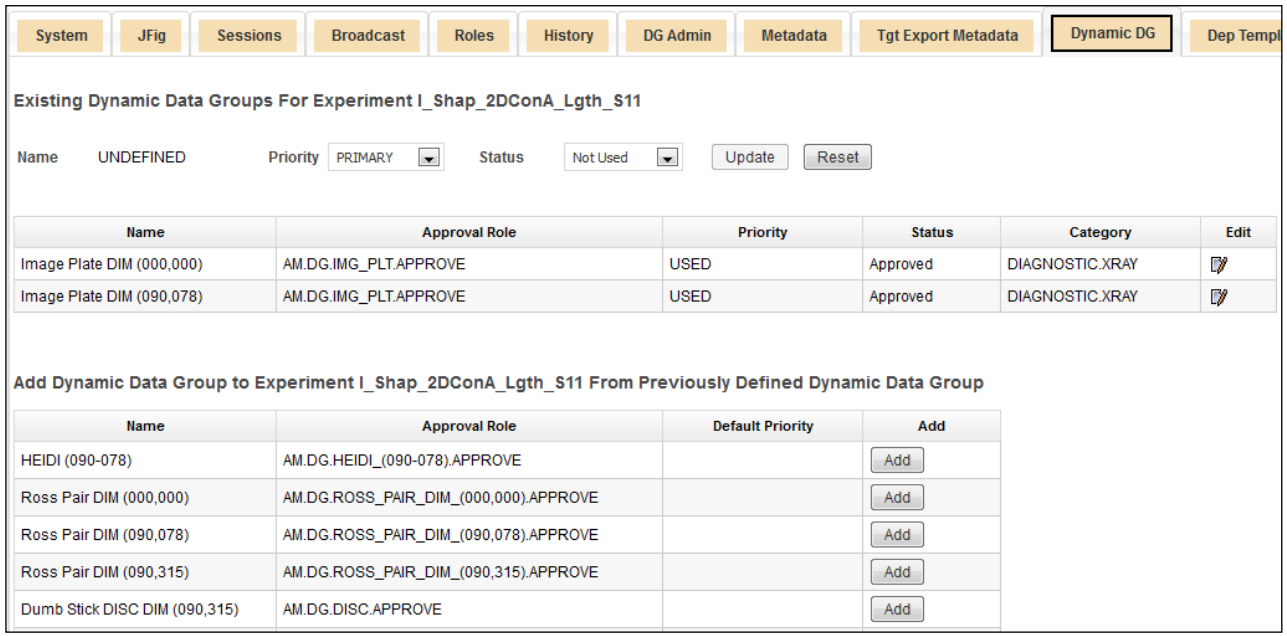
Owner	Dependent Data Group
BLIP	TALIS
	NOL
DIM POINTING (000,000)	GXD DIM (000,000)
DIM POINTING (090,078)	HGXD DIM(090,078)
Target System (090,239)	TALIS
NAD - Position 1 DIM (090-078)	DIM POINTING (090,078)

Approval Manager Lessons Learned: Dynamic Data Groups

- Some diagnostic instruments lack *configurable* support in CMT
  - Some diagnostic devices are “captives” of primary instruments, part of their hardware but not independently configurable
  - An instrument may not be planned for regular use at NIF so explicit CMT support is not warranted
- Enable review & approval for these by defining Dynamic Data Groups for them, then instantiating those DDG’s in experiments that need them
  - DDG definition includes a name, an approver role, and a default priority
  - Each DDG definition is saved permanently for reuse as needed
  - DDG may be created on an experiment by manual intervention or by programmed logic

DDG’s instantiated on this experiment

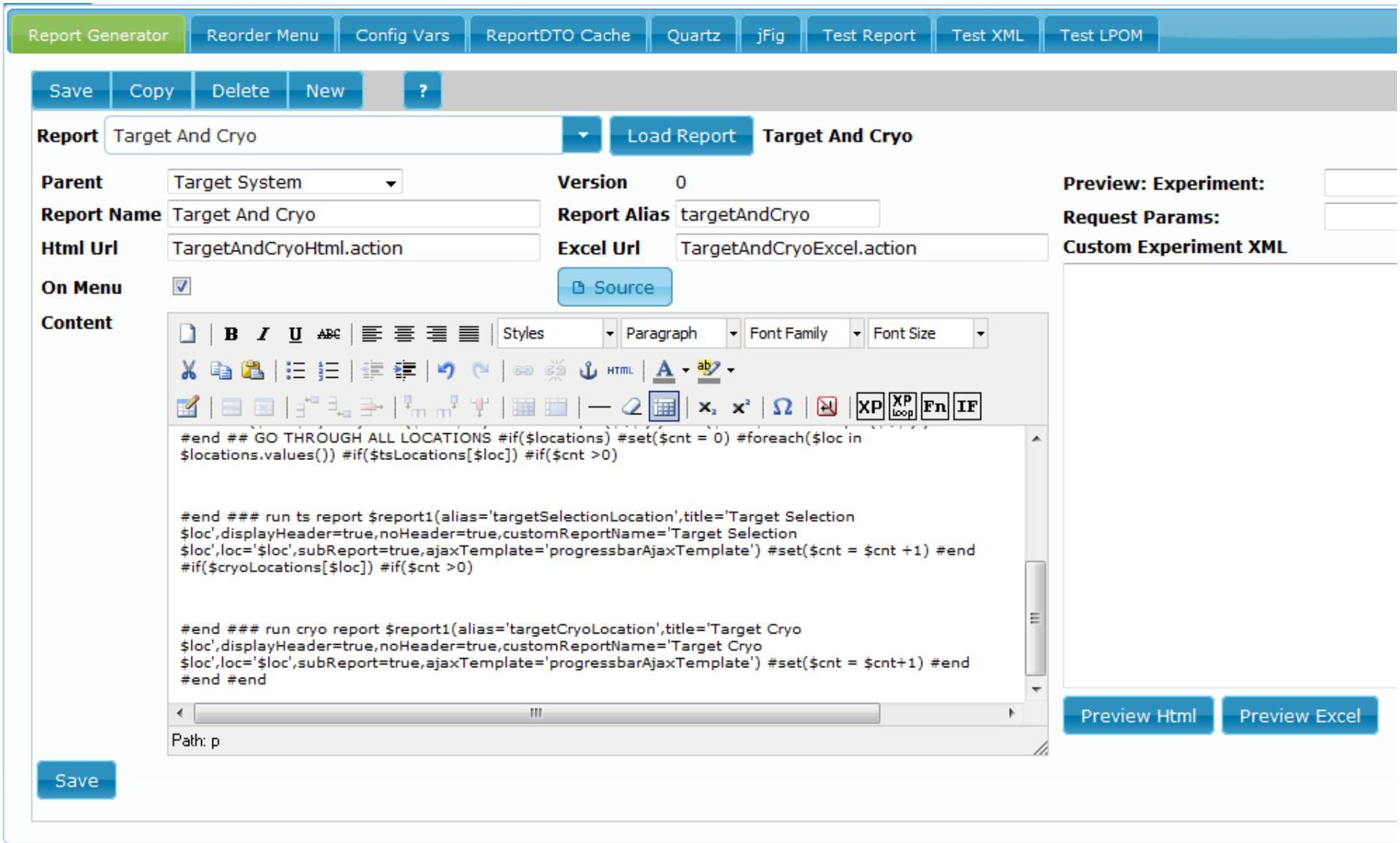
List of possible DDG’s



Shot Setup Reports

- Generates electronic reports (HTML, Excel) for each data group to support review and approval
- Launched from report links in Approval Manager
- Three primary components
  - Report generating scripts stored as fields in a database
  - ShotSetupReports Java application – retrieves experiment XML and report script from database then executes script against XML
  - ShotSetupReports Admin page with report script editor
- Critical design aspect – storing report scripts as data
  - A typical change is to update an XPath for getting a parameter from experiment XML
  - Usually performed within minutes (if not seconds) of receiving request
  - System stays online throughout update cycle
  - Updated report is available as soon as updated script is committed to database

Shot Setup Reports: Script Editor




NIF