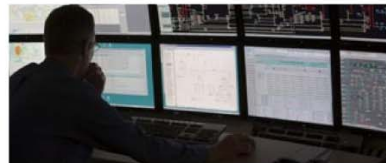


Constraints Development Process

SO Industry Workshops
April 2007

Greg Spence
Operations Planning Manager

TRANSPower



SYSTEM OPERATOR

Constraints Development Process: Agenda

- provide insight to the constraints development process
- constraint lifecycle
- linkages to key operational processes
- constraint quality assurance

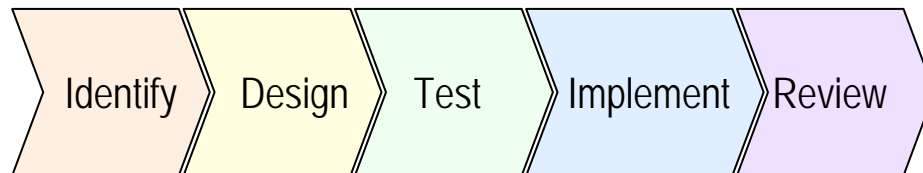
Lifecycle

- constraint purpose

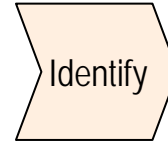
The purpose of a constraint is to define the operational parameters of system capability within SPD.

- constraint lifecycle -5 phases

- identify
- design
- test
- implement
- review

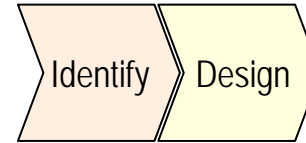


Identify



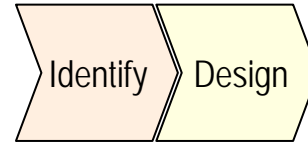
- planning time frame -3 inputs trigger need for constraint:
 - outage planning –typically 4-6 weeks from outage start
 - commissioning (Gen & Tx) – typically 4-6 weeks from commissioning
 - ratings change –2 weeks from advised date of change to capability
 - timing influenced by numerous variables:
 - outage timing
 - provision of asset capability information
- real time system management:
 - immediate temporary constraints can be applied
 - unusual or unforeseen circumstance :
 - forced outages
 - forced system re-configuration
 - rarely used.

Design



- single outage constraint - typically 6-8 hrs effort
 - developing credible range of scenarios
 - powerflow studies to identify critical branches
 - confirming branch ratings and flow direction conventions
 - determining factors for load distribution and pre/post contingent loading
 - entering data into ACI constraints builder, peer review and market notification
- designed for credible range of load and generation scenarios
 - generation north/south
 - hydro wet / dry
 - load peak /trough
- use of ACI constraint builder displays to eliminate data entry error risk
 - drop down menus
 - conductor thermal operating characteristics

Design



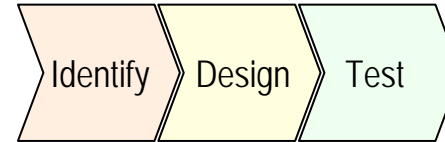
Screen shot of ACI constraints builder

The screenshot shows a web browser window titled 'View CAG - Microsoft Internet Explorer' displaying the 'View Constraint Data - OTA_WKM_2_S_O_1of2' page. The interface is a form for defining a constraint. Key fields include:

- MDE Constraint Key:** 20656
- Object Type:** Group
- Constraint Class:** Outage
- Constraint Type:** Thermal
- Season:** Summer
- CAN Description:** The effect of this constraint is to manage flows through Otahuhu - Whakamaru 1 for a contingency of Otahuhu - Whakamaru 3 when Otahuhu - Whakamaru 2 is out of service
- MDE_DESCRIPTION:** Pre-contingency flows from Whakamaru to Otahuhu
- Protected Circuit Reference Branch:** OTA_WKM1.1.OTA_WKM1.1
- Contingent Circuit Reference Branch:** OTA_WKM3.1.OTA_WKM3.1
- Equation:** $-1.32 * OTA_WKM1.1 + -0.29 * OTA_WKM3.1$
- RHS:** 278.4 MW
- Background:** When Otahuhu - Whakamaru 2 is out of service, a contingency on Otahuhu - Whakamaru 3 could overload the Otahuhu - Whakamaru 1
- Assumption:** Summer Ratings of 529.7A on Otahuhu - Whakamaru 1
- Grid Configuration:** (Empty field)
- Conductor / Temperature:** Goat 50 degrees (summer)
- Protected Circuit Pre-Contingent Flow:** 160.6 MW
- Contingent Circuit Pre-Contingent Flow:** 240 MW
- Protected Circuit Preloading Current:** 409 A
- Protected Circuit Nominal Voltage:** 220 kV
- Protected Circuit Post-Contingent Flow:** 231 MW
- Post Contingency Voltage:** 227.1 kV
- Protected Circuit Post-Contingent Flow:** 0 MVAR
- Change Reason:** New
- Powerflow Results Summary:** Edit
- EMS Solution Report:** Edit
- Effective Date:** 27/10/2004 13:53:58
- End Date:** (Empty)

Buttons for 'Close' and 'Done' are visible at the bottom of the window.

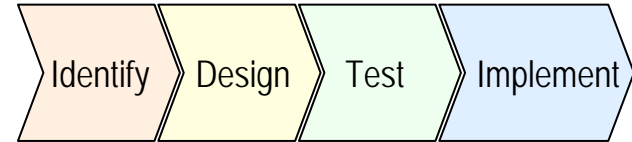
Test



constraint testing and validation

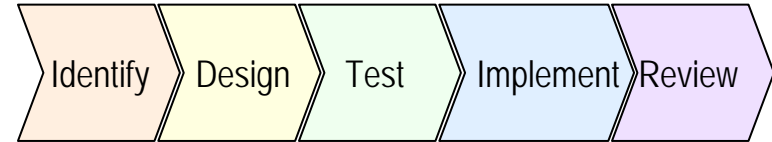
- Powerflow testing / peer review
 - utilised for all constraints
 - thermal / component limit constraints
 - permanent / outage constraints
 - load flow conditions re-created
 - checks for:
 - branches, flow directions, distribution factors, system conditions
- type testing
 - utilised in addition to powerflow testing and peer review for new class or type of constraint
 - e.g. mixed integer HVDC constraints, voltage stability constraints
 - offline SPD testing in ESCHED
 - tested for range of dispatch scenarios

Implement



- loading into SO real time tool set
 - constraints data transfer from ACI to MDE (PSCHED)
 - available in MDE (PSCHED) to be scheduled as required
- market notification
 - implementation of “new constraint situation” is identified
 - new permanent constraint due to re-rating or commissioning of new equipment
 - 2 week consultation period
 - generation /load scenarios provided with description of constraint effect via Customer Advice Notice (NMDATA)
 - scheduling of existing constraints in PSCHED
 - constraints library posted on SO website
 - notified 1 week in advance
 - automatic constraint notification via M-CO Energy Traders account.

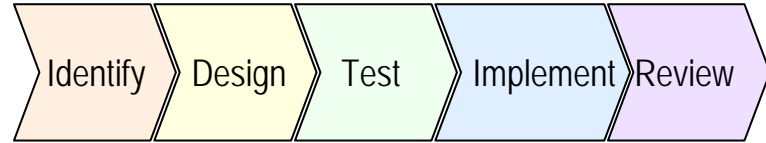
Review



review of constraint performance

- daily review and look-ahead
 - unusual or unexpected constraint/dispatch outcomes identified and corrected for pricing
 - market analysts and operations engineers for off line analysis
- monthly reporting on constraint activity
 - SO performance report to EC
 - constraints that bound, number of trading periods and accuracy
 - Inaccuracies / unexpected results tagged for review

Review



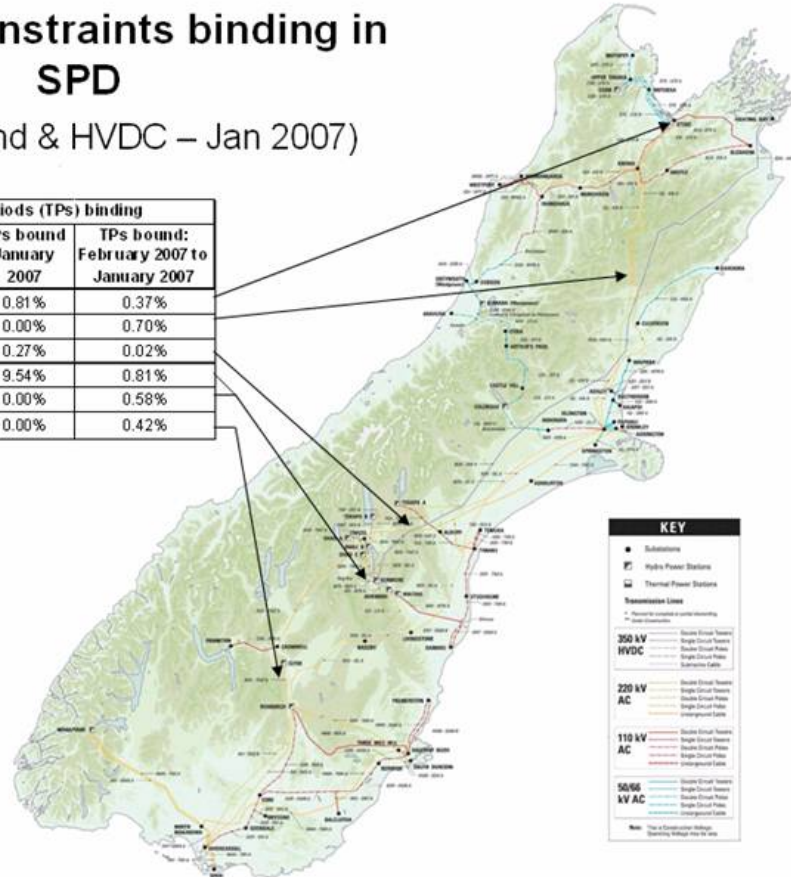
Constraint Accuracy Report – January 2007

Security constraints binding in SPD

(South Island & HVDC – Jan 2007)

Security constraints: % trading periods (TPs) binding		
South Island	TPs bound January 2007	TPs bound: February 2007 to January 2007
Wairakei T3	0.81%	0.37%
Wairakei-Kikwaka (stability)	0.00%	0.70%
Benmore-Haywards	0.27%	0.02%
Benmore-Benmore (outage)	9.54%	0.81%
Benmore-Waitaki (outage)	0.00%	0.58%
Wairakei-Twitzel (outage)	0.00%	0.42%

The above constraints have been binding for a minimum of 4 trading periods in the current month and/or 48 trading periods in the last 12 months



KEY

- Substations
- Hydro Power Stations
- Thermal Power Stations
- Transmission Lines
 - As shown in current or construction
 - Proposed

350 kV HVDC

- Double Circuit Transfer
- Single Circuit Transfer
- Single Circuit Power
- Submarine Cable

220 kV AC

- Double Circuit Transfer
- Single Circuit Transfer
- Single Circuit Power
- Single Circuit Power
- Interconnector Cable

110 kV AC

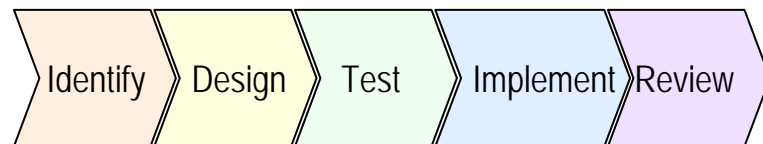
- Double Circuit Transfer
- Single Circuit Transfer
- Single Circuit Power
- Single Circuit Power
- Interconnector Cable

50/66 kV AC

- Double Circuit Transfer
- Single Circuit Transfer
- Single Circuit Power
- Single Circuit Power
- Interconnector Cable

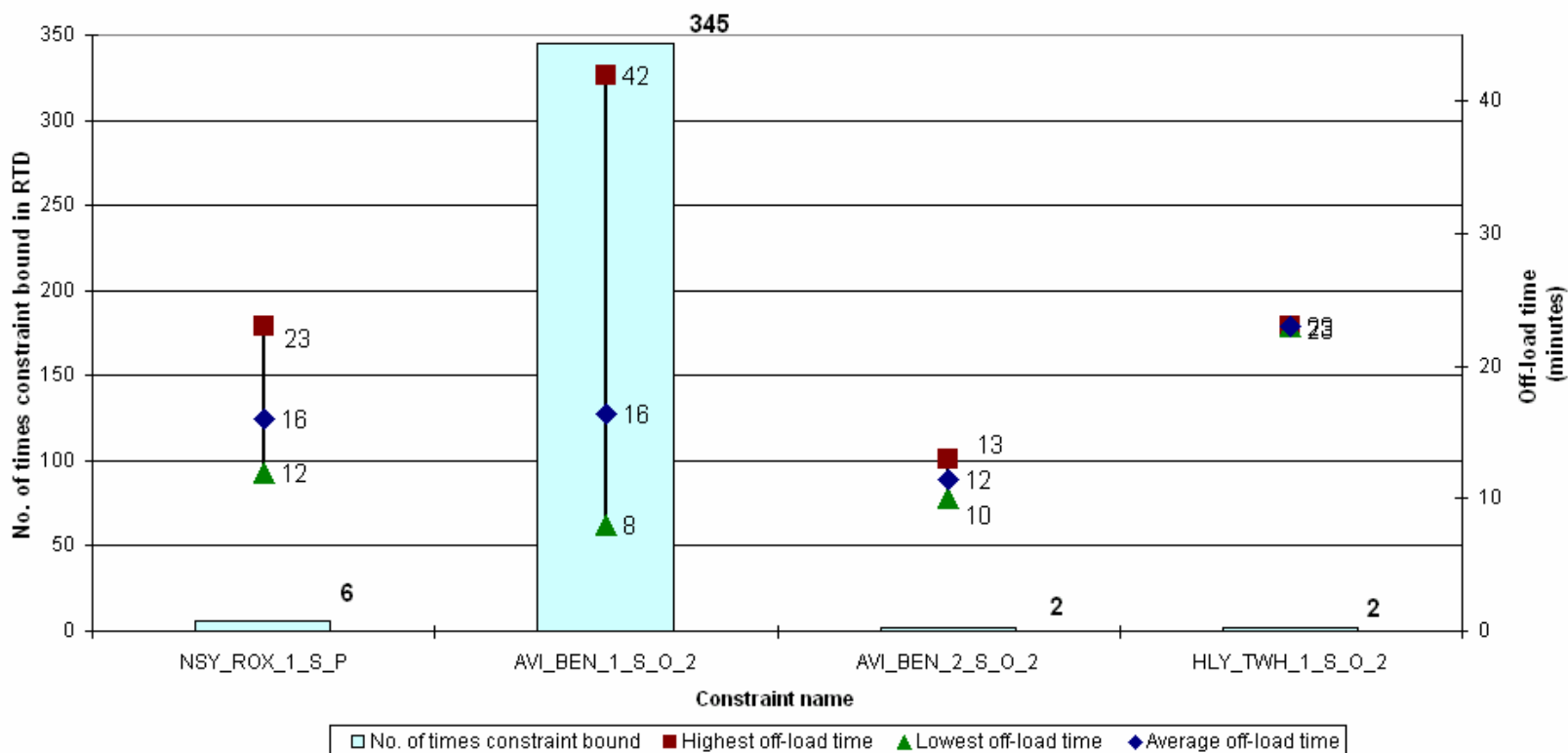
Note: High Voltage Interconnector Cables are shown in blue.

Review

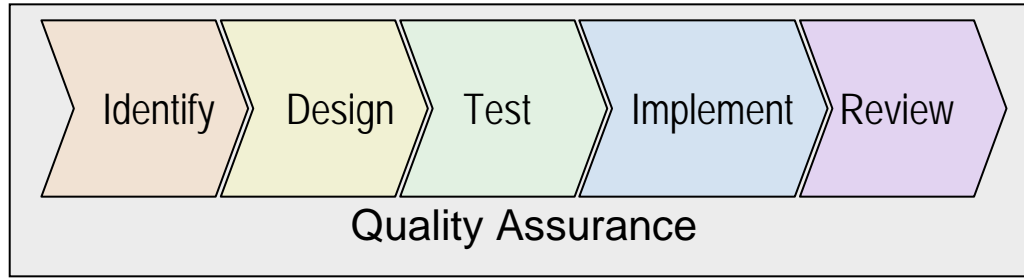


Constraint Accuracy Report –January 2007

Average Off-Load Times & No. of RTD Bindings for Constraints with Thermal Limits

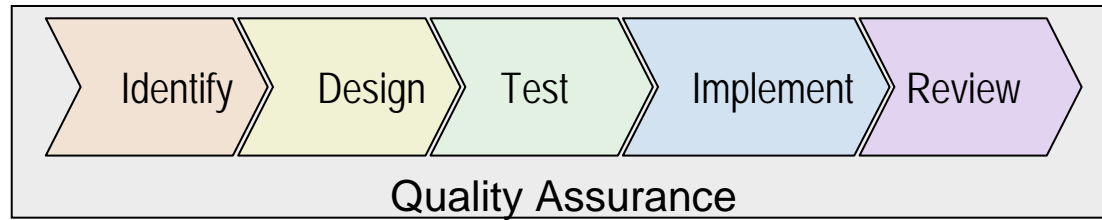


Quality assurance



- quality assurance measures
 - process documentation
 - process training and competency assessment
 - peer review and type testing
 - data integrity checks between ACI / PSCHED
 - SO internal audit teams
 - event review process

Constraints Development Process: further information



- further information on constraints at:
 - library of current constraints
 - <http://www.transpower.co.nz/?id=5979>
 - constraint process documentation
 - <http://www.transpower.co.nz/?id=5979>
 - monthly reporting constraint accuracy –System Performance Report
 - <http://www.transpower.co.nz/?id=5978>