The view from 30,000 feet:

Successful Retrofit Projects account for the impacts to the entire network of operating departments.
Harder Than It Looks
Retrofit Projects in Operating Plants

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ISPE
Overview

Project lifecycle stages:
  Design – Planning – Execution – Completion
  Key Considerations for each

Areas of Concern

'War Stories'

Techniques & Tools

Q&A
'Retrofit' Project?

Any project executed post-licensure

whether the Plant is....
Retrofit Projects are executed:

- During Plant-wide Shutdowns
- Concurrently with manufacturing

Presentation focus: Concurrent with Operations
Principal Concerns of Retrofit Projects

Manufacturing:
"When can we return to production?"

Quality:
"How can we prove no adverse effect on:
• Processes under modification
• Product concurrently in-process?"

Regulatory:
"How can we prove no adverse effect on regulatory filings?"
Define Scope...

Design / Plan...
Procure Services and Equipment...
Install, Qualify...
Successful Retrofit Projects account for the impacts to the entire network of operating departments.
## Comparative Schedule

### Greenfield Project
- Design
- Planning
- Execution
- Completion

### Retrofit Project
- Design
- Planning
- Execution
- Completion
Comparative Schedule

Greenfield Project
Design
Planning
Execution
Completion

Retrofit Project
Design
Planning
Execution
Completion
Retrofit Concerns

Design
- Design Basis Accuracy
- Utility Supplies
- Custom Designs

Execution

Planning

Completion
Design Approach

Involve key stakeholders as early in concept phase as possible:

- Manufacturing, including supply chain
- Facilities, QA, QC, Validation, Regulatory, HSE
- KNOW THE DEAL BREAKERS

Identify likely impact areas

- Maintain adequate operational accessibility
Design Issues

Design basis accuracy

- Don’t assume record set is current
- Walk it down – even the “as-builts”

  Check for in-progress redlines!

- Verify performance data
- Investigation work needed?

Look beyond Utility Generation and Storage

- Can new uses ‘crash’ a system?
- Consider max test loads, not just operating
Design Issues

Custom Designs
Troubleshoot before installation

Require that vendor FAT conditions match site conditions
- Plan supplemental vendor capabilities or consider alternate FAT site
- Start training during FAT (mfg, QC, maint, etc.)
Retrofit Concerns

Design
- Design Basis Accuracy
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- Custom Designs

Execution

Planning
- Impacts to Risk Mitigation
- Resource Loading
- Vendor Management
- Return to service

Completion
Environmental Risks

• How to verify environments unaffected by retrofit work? *(build, then clean v. clean while building)*

• Cleaning roles *(contractor, mfg., routine)*

• Gowning requirements for project space *(mfg. requirements trump construction)*

• How to traverse active space?

• HVAC impact during retrofit
  – Airflow profiles
  – Sampling requirements
  – Mark a clearance zone around Low Returns to avoid blockage by construction equipment or materials
  – Consider proactively change HEPAs
Data / Process Control Risks

Plan the sequence in which systems should be shut down and started up

- Proper inter-system communication can be affected by startup order
- Avoid an avalanche of error messages and interlocks

Record and confirm version numbers pre-shutdown

Make 'as-left' backups of code and parameters

- Especially systems remaining unmodified

Ensure all PLC/DCS backup batteries are refreshed before shutdown

- Avoid loss of parameters, restoration of obsolete code
Resource Planning 1

Internal departmental support

- QC: sampling & testing
- Facilities / Metrology / Cleaning Staff
- Manufacturing: SOP revisions
- Training for trades, contingent staff, Mfg
- QA and Validation: commissioning and qualification

Pre-plan the Quality Processes

- for planned activities and contingencies
- Do not use EQMS (e.g. TrackWise) as a PM tool

Most Critical: ready access to

empowered and informed Decision Makers
Resource Planning 2

External Contractor/Trades support:

- Key consideration: Lead Times
  - Vendor Qualification / Audits
  - Requests For Quotations
  - PO Approval and other commercial processes
  - Training: Safety, Quality, Permitting & Reporting
- Space - desks, office trailers, storage, parking, lockers
- Connectivity - 'guest' network or hotspots

Supplies

- Gowning materials
- Cleaning
- Production Consumables
- Waste Removal / Recycling
Returning to Service

- Not just a matter of completing the mechanical work
- Proactively plan:
  - Preparation of TOPs concurrent with construction
  - Handoffs: Construction -> Commissioning -> Validation -> Manufacturing – for each system
  - Release of utilities to support CQV schedule
  - Ramp up Commissioning while Construction ramps down
  - Technical Support of CQV activities:
    - Training of Mfg / Facilities / QC on new equipment
    - Keep Trades available through commissioning: things break, flaws discovered, adjustments are required
Retrofit Concerns

Design
- Design Basis Accuracy
- Utility Supplies
- Custom Designs

Execution
- Communication
- C&Q / Training Overlap
- Decommissioning

Planning
- Impacts to Risk Mitigation
- Resource Loading
- Vendor Management
- Return to service

Completion
Keep A Manufacturing Focus

Develop a project-specific Communication Tool

- Mfg needs access to (and approval of) the up-to-date, detailed schedule of activities - avoid surprises!

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<th>Weekday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
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Orient thinking toward impact avoidance

- Absolutely critical to have 24/7 coverage of 'crisis team' - empowered decisionmakers from Mfg., Quality and Regulatory

Develop a consensus method for communicating changes to the project plan - BOTH WAYS
Some Not-So-Obvious Concerns

- **Startup & C/Q/V**
  - Use as training opportunity
  - Consider training dependencies
  - Contract Lab Services? Utility Capacity?

- **Decommissioning**
  - Open Investigations, CAPAs, Change Controls?

- **Vibration / Noise**
  - Construction (trenching, etc.) / equipment movement

- **Utility Isolation**
  - Hot Taps, Hot Work, Label Outlets for Contractor Use

yet sometimes....
...things just don't go according to plan
Murphy's Law

What if...

- Manufacturing doesn't finish on time
- Equipment is not available or found in an unexpected condition
  - deviation investigation, out of calibration, etc.
- State or local inspection issues
- Surprises in the walls
Murphy's not done...

- Non-routine use of systems cause upsets
  - excessive flow, increased velocities, spikes
  - biofilms flaking from drying out

- Opportunities for visual inspection may have unintended consequences
  - what if you find rouge?

- Idle systems can freeze during Winter Shutdowns

- Project Activities create damage

- Repairs interfere with Manufacturing operations
Retrofit Concerns

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Execution
- Communication
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Planning
- Impacts to Risk Mitigation
- Resource Loading
- Vendor Management
- Return to service

Completion
- Qualification
- Doc Revision
- Training (non-Mfg)
- Regulatory Filings
**Defining 'Done'**

**Completion Requirements**

- **SOPs:** don't forget PM, QC, Cleaning, etc.
- **Resources for timely closeouts**
- **Approach:** Guilty Until Proven Innocent

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<tr>
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| SOP Revisions | Work Orders | Training / OJT | Regulatory Filings | Action Notices | Change Controls | Validation Reports | As-Built Drawings | TOPs | Mechanical Work |
Returning to Service

Quality Requirements (waters, CS, EM, HEPA...)

- Sampling / testing / release
- Consider dependencies (can WFI sampling begin if RO/DI is provisionally or fully released?)
- Contingency Plans for failed samples

Plan the Activation of New Documentation

- SOPs - Manufacturing, Cleaning, EM, Maintenance...
- Training - new curricula, OJT's, other prerequisites - ex: QC training for sampling on new equipment
- Consider dependencies to be ready to operate (can we train on approved drafts?)
Key Takeaways:
Key Takeaway 1

Access to the team of Decision Makers

- An informed team can make good decisions fast
Key Takeaway 2
Resourcing for Added Activities

- CQV Support: Mfg + Eng + Validation
- Document Revision / Training
  - Monitoring / Sampling
  - PM / Metrology
  - Cleaning
Key Takeaway 3

Detailed Plan for Return to Service

- Agree Dependencies in Advance
- Agree Contingencies in Advance
- Perform a Dry Run with the Decision Makers
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