Sandia National Laboratories
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subject: Building 1090 Modifications Lessons Learned

The purpose of this document is to capture and disseminate lessons learned from the Sandia National Laboratories (SNL) Building 1090 modification project that took place from 2013 to 2018. The following sections summarize the drivers, issues encountered and lessons learned at each phase in the project.

Drivers/Initial issues

1. Initial building design had to be constructed within 5-million-dollar budget (~2004).
    a. Cost constraints led to undersized process ductwork and incompatible materials (i.e. stainless steel) used for construction.
        i. Previous experience with other lab spaces at SNL proved that facilities and design firms do not see problems associated with stainless steel ductwork in laboratories.
    b. Electrical deficiencies in initial construction led to high frequency of breakers being tripped.
    c. Emergency shower and eyewash drainage system poorly designed and built, leading to inadequate drainage.
    d. Main building chiller unit substandard and nonstandard build, leading to frequent maintenance and repairs.
    e. Positive air pressure differential from lab spaces to office spaces, leading to nuisance smells in office spaces coming from the lab spaces.
    f. In a lab emergency event, personnel from the office side of the building would have to move toward the hazard (i.e. lab side) to exit the building.
2. In 2009, SNL facilities conducted energy audit and found Building 1090 to be very high consumer of power. This was due to undersized ducts from the original construction that required fans to be operated at a high velocity to maintain face velocity in hoods.
    a. Variable frequency drives for two building exhaust fans and installation of new, correctly sized ductwork lowered energy use.
    b. Still have incompatible ductwork for acid digestion processes.
3. In 2012, extended power outages occurred while acid digestion work was being conducted.

    a. All ventilation shut down while digestion was in process, creating a hazard to workers.
    b. It was discovered that there was no emergency lighting in lab spaces because it was not part of the original building design.
4. Acid digestions conducted in stainless steel ductwork and hoods caused issues.
    a. Condensate collected within hoods due to insufficient air flow to expel fumes.
    b. Corrosion of control valves led to leakage into ceiling spaces.

<u>Issues Encountered during planning, design and construction (2013-2018)</u>

1. Not enough stakeholder/end user resources to support the project.
    a. One full time employee from Radiation Protection Sample Diagnostics (RPSD) laboratory largely interfaced with designers and construction contractors.
    b. Not enough time for one full time employee to review plans, designs, etc.
    c. Many competing routine and non-routine laboratory operations and projects did not allow other personnel to adequately participate in the planning and execution of the project.
2. Still have positive pressure differential from laboratory space to office space during windy conditions.
    a. Firewall design issue was not identified until after construction modifications were completed. Issue identified from newly installed differential pressure monitors.
3. Mice were encountered in the ceiling spaces.
4. Floor coating bubbled up and needed multiple coatings to be resolved.
5. Radiological and chemical deactivation and decommissioning (D&D) of existing equipment and facilities required contractors with Radiological Worker-II training for certain D&D which added substantial costs.
6. Many hazard analyses, safety documents and permits had to be updated.

<u>Lessons Learned</u>

The following list contains lessons learned and recommendations for other Department of Energy laboratories that seek to construct new analytical laboratory facilities or modify existing spaces:

1. Insist on a design firm that has previous experience with designing laboratory spaces.
2. Need knowledgeable people (stakeholders and consultants) to carefully and thoroughly review design plans.
3. Need emergency lighting in design plans.
4. Consider building-wide surge protection in plans.
5. Need ventilation/Industrial Hygiene review of design plans.
6. Need "As Low As Reasonably Achievable" (ALARA) review from Radiation Protection Subject Matter Expert in design stage.
7. Need to start National Environmental Policy Act (NEPA) checklist early in the process.

8. Need electrical safety check of new systems/equipment.
9. Need frequent update meetings during construction phase to plan around lab operations.
    a. Planning for outages, staging construction materials, scheduling construction work activities during normal and off hours.
10. Access control for contractors into radiological areas during construction phase.
11. Plan for how doorways are going to used (i.e. if equipment is to be moved through doors, plan for larger than standard openings).
12. Evaluate need for windows on doors and door type (i.e. crash bars, size).
13. Evaluate the need for differential pressure monitors in critical areas.
14. Evaluate backup power and lighting needs and options for critical operations and areas.
15. Match hoods and ducting materials to be compatible with chemicals and radiological needs (i.e. High Efficiency Particulate Air (HEPA) filters).
16. Need to have independent post-construction evaluation.
17. Consider new traffic routes and how they will impact workflow.
18. Consider emergency evacuation routes and options.
19. Evaluate options for installing house gases.
20. Consider ergonomic hazards associated with moving existing equipment.
21. Need both Radiation Protection and Industrial Hygiene input on evaluating potential hazards of D&D in planning stage.
22. Consider taking multiple pictures of ductwork, electrical conduit, etc. above the ceiling space while the ceiling is removed for future reference.
23. Need plan for storing construction designs, documents, plans, photos for future reference.
24. Consider construction log/weekly summary to capture lessons learned and metrics for management reporting.

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