DESIGN STATUS
OF THE POST IRRADIATION EXAMINATION (PIE) HOT CELLS AT McMaster UNIVERSITY
HAMILTON, ONTARIO, CANADA

HOT CELLS EUROPE 2012

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PRESENTATION AGENDA

● MESSAGE – PROVIDE DESIGN STATUS UPDATE
● BACKGROUND
● ORIGINAL DESIGN
● DESIGN EVOLUTION AND CURRENT APPROACH
● CURRENT DESIGN
● RESULTS OF RE-FOCUS IN DESIGN APPROACH
CENTRE FOR ADVANCED NUCLEAR SYSTEMS

RESEARCH INFRASTRUCTURE BEING ESTABLISHED AT McMaster University & FUNDED BY FEDERAL AND PROVINCIAL GOVERNMENT GRANTS

PIE FACILITY

ATOMISTIC LEVEL MATERIAL CHARACTERIZATION (SEM/FIB, TEM, 3-D ATOM PROBE)

ALLOY DEVELOPMENT + SCW MATERIALS TESTING

NUCLEAR SAFETY THERMAL HYDRAULICS TESTING FACILITY
TYPICAL DESIGN STEPS

- FOR TYPICAL FACILITY DESIGN THE FOLLOWING WOULD BE DEFINED,
  - MISSION OF THE FACILITY
  - SAMPLE SIZE AND USE
  - EQUIPMENT REQUIRED TO ACCOMPLISH MISSION
- AFTER THIS LEVEL OF DEFINITION, THE HOT CELLS ARE DESIGNED AROUND THE EQUIPMENT
- TYPICAL DESIGN SEQUENCE IS DISPLAYED ON THE NEXT SLIDE
TYPICAL DESIGN STEPS

- LOCATION ALTERNATIVES
- SELECTED LOCATION
- DESIGN CRITERIA
  FUNCTIONAL & OPERATIONAL REQUIREMENTS
  - SPECIMENS
  - EXAMINATIONS
- CONCEPTUAL DESIGN
- CONSTRUCTION TESTING START-UP
- COST ESTIMATING
- FUNDING
- OPERATIONS & MAINTENANCE

PRELIMINARY & FINAL DESIGN

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THE CHALLENGE

- DESIGN OF THE MCMASTER PIE SHIELDED FACILITY HAS EXPERIENCED THE FOLLOWING CHALLENGES
  - MULTIPLE USERS CONTRIBUTING TO MISSION DEFINITION (COMPETING/CONFLICTING NEEDS)
  - THE MISSION WAS DEFINED AT A HIGH LEVEL – DETAILED REQUIREMENTS STILL EVOLVING
  - ANALYTICAL REQUIREMENTS NOT COMPLETELY DEFINED
  - ELEMENTS OF THE EQUIPMENT NOT SELECTED OR SPECIFIED

- THIS SITUATION CONFOUNDED DESIGN DEFINITION

- FURTHER COMPLICATING THE PROCESS WAS THE FACT THAT A SPECIFIC LOCATION WAS SELECTED TO INSTALL THE HOT CELL FACILITY
ROOM 105 TANDEM ACCELERATOR BUILDING

ROOM SPECIFICS
• EAST-WEST
  • 65 FEET (19.7 meters)
• NORTH SOUTH
  • 24 FEET (7.3 meters)
GIVEN THE CHALLENGES AND RESTRICTIONS DESCRIBED ABOVE, A CONCEPTUAL DESIGN WAS DEVELOPED

REFER TO THE FOLLOWING SLIDE
ISOMETRIC VIEW – LOOKING NORTH

- WASTE MANAGEMENT CELL
- SAMPLE PREPARATION CELL
- SUPPORT CELL
- MECHANICAL TESTING CELL
- LIGHT MICROSCOPY CELL
- SAMPLE TRANSFER GLOVEBOX
- LOW ACTIVITY WASTE COLLECTION
- MOVABLE TEMPORARY SHIELDING

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ALTHOUGH FUNCTIONAL, IT WAS NOT OPTIMAL AND HAD LIMITATIONS

HOT CELL ISSUES

- “L” SHAPED ARRANGEMENT
- UNUSABLE CORNER SECTION
- LARGE NUMBER OF SEPARATE COMPARTMENTS
- LARGE FOOTPRINT IN THE ROOM, SMALL SPACE INSIDE THE HOT CELLS
- REQUIRES SIGNIFICANT AMOUNT OF CONSTRUCTION MATERIAL
ORIGINAL CONCEPTUAL DESIGN

ROOM ISSUES

- SEM/TEM ANNEX WAS SMALL AND LOCATED IN THE CORNER OF THE ROOM
- SUPPORT EQUIPMENT AND UTILITY ROOM IS LOCATED OPPOSITE THE HOT CELL
  - INTERFERES WITH CELL OPERATIONS
  - LIMITS TRAVEL AND USE OF THE OVERHEAD CRANE IN THE ROOM
NEW DESIGN APPROACH

- The design team recognized:
  - Consensus on mission definition would be difficult to achieve
  - Functionality of original conceptual design could be improved
  - Cost of original design could be reduced
- A paradigm shift in design approach was required:
  - Shifted design focus from specific equipment to operational flexibility
  - Allow equipment selection to occur later
NEW DESIGN APPROACH

THE TEAM CONDUCTED A VALUE ENGINEERING STUDY (VES) TO:

- EVALUATE AVAILABLE MISSION INFORMATION
- CONSIDER MISSING INFORMATION
- ASSESS AVAILABLE SPACE FOR THE HOT CELL FACILITY
- ESTABLISH IMPORTANT DESIGN CRITERIA
- IDENTIFY AND EVALUATE OPTIONS
- COMPARE RELATIVE COST OF VARIOUS OPTIONS
- SELECT PREFERRED OPTION TO ADVANCE DESIGN
THE RESULTS OF THE VES HAVE BEEN IMPLEMENTED AND THE DESIGN HAS ADVANCED TO FINAL DESIGN PHASE

REFER TO THE FOLLOWING SLIDE
ADVANCED DESIGN SOLUTION

- Receiving Cell
- reciprocating elevator
- Operations Area
- Operations Area
- Machining/Waste Management Cell
- Canyon Cell - Sample Preparation Area
- Canyon Cell - Microscopy and Support Area
- SEM/TEM Annex

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ADVANCED DESIGN SOLUTION

● HOT CELL FEATURES
  ● LINEAR – THE CORNER “DEAD ZONE” HAS BEEN ELIMINATED
  ● IMPROVED OPERATIONS AND MATERIAL FLOW
  ● SEPARATE CELL COMPARTMENTS HAVE BEEN REDUCED FROM SEVEN TO THREE
    ● RECEIVING (HEAVY SHIELDED)
    ● MACHINING AND WASTE MANAGEMENT (HEAVY SHIELDED)
      ● LATHE
      ● WASTE LOAD OUT
      ● TENSILE TESTING
ADVANCED DESIGN SOLUTION

● HOT CELL FEATURES, CONTINUED

● CANYON (LIGHT SHIELDED)
  ● LARGE CONTINUOUS CELL
  ● SAMPLE PREPARATION
  ● LIGHT MICROSCOPY
  ● THREE WORKSTATIONS
  ● ISOLATION BARRIER FOR SAMPLE PREPARATION

● ENTRY / EXIT GLOVEBOX ON EAST END OF HOT CELL
ADVANCED DESIGN SOLUTION

● GENERAL HOT CELL FEATURES
  ● ROOF ACCESS HAS BEEN ELIMINATED
  ● LIGHTING HAS BEEN MOVED IN-SIDE CELL
  ● HVAC DESIGN HAS BEEN REDUCED AND SIMPLIFIED
  ● GENERIC ELECTRICAL SERVICE HAS BEEN INCLUDED
    ● SEVERAL 120VAC AND 220VAC OUTLETS THROUGHOUT CELL
    ● INDIVIDUAL OUTLETS CAN BE ENERGIZED SEPARATELY BY MANUAL SWITCHES OUTSIDE THE CELL
  ● WORK SURFACE ARE GENERIC AND FLEXIBLE
    ● GENERAL ALIGNMENT PINS
    ● EQUIPMENT MOUNTING PLATE ENGAGE ON PINS
    ● EQUIPMENT IS FASTENED TO MOUNTING PLATE IN PREFERRED ORIENTATION
GENERAL HOT CELL FEATURES

SHELFED WALL CONSTRUCTION

- COMPOSITE SHIELDING DESIGN
- TWO INCH STEEL PLATES FORM INSIDE AND OUTSIDE SURFACES AND SERVE AS CONCRETE FORMS
- THE FORMS ARE MODULAR AND EASY TO MANEUVER
- THE FORMS CAN BE INSTALLED USING THE OVERHEAD CRANE IN THE ROOM
- THE STEEL WALLS (FORMS) ARE SITUATED AND CONNECTED TO THE FLOOR
- THE WALLS ARE THEN FILLED WITH HIGH DENSITY CONCRETE
- THE TEAM CONTINUES TO SCRUTINIZE THE SOURCE TERM TO FURTHER REDUCE THE SHIELDING REQUIREMENTS
ADVANCED DESIGN SOLUTION

ROOM FEATURES

- Etching operations have been moved outside cell to a shielded glovebox
  - Prevents etching of the cell window
- The SEM/TEM area has been relocated to the east end of the facility
  - The area is more efficient
- Expands the range of movement for the overhead crane in the room
RESULTS

- The approach implemented through the VES has allowed the design to advance.

- The current design is:
  - Efficient
  - Cost effective

- The current design:
  - Maximizes flexibility
  - Allows equipment to be selected and updated
  - Provides an opportunity for mission changes in the future
CURRENTLY THE STATUS OF THE PROJECT IS

- 60% DESIGN COMPLETE
- ENTERING THE FINAL DETAILED DESIGN PHASE
- INTERFACING HAS BEEN INITIATED WITH THE ARCHITECTURAL GROUP TO DEFINE THE FACILITY MODIFICATIONS AND UPGRADE REQUIREMENTS
- CAPITAL COST ESTIMATE IS BEING UPDATED
- INITIATING CONVERSATIONS WITH THE LICENSING AND PERMITTING ORGANIZATIONS
- ENGAGING FABRICATION AND CONSTRUCTION FIRMS
THANK YOU FOR YOUR TIME!