



# DESIGN STATUS

OF THE POST IRRADIATION  
EXAMINATION (PIE) HOT CELLS AT  
McMASTER UNIVERSITY

HAMILTON, ONTARIO, CANADA



# HOT CELLS EUROPE 2012



Inspiring Innovation and Discovery

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Engineering | Architecture | Design-Build | Surveying | GeoSpatial Solutions



# PRESENTATION AGENDA

- MESSAGE – PROVIDE DESIGN STATUS UPDATE
- BACKGROUND
- ORIGINAL DESIGN
- DESIGN EVOLUTION AND CURRENT APPROACH
- CURRENT DESIGN
- RESULTS OF RE-FOCUS IN DESIGN APPROACH



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# BACKGROUND

- 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



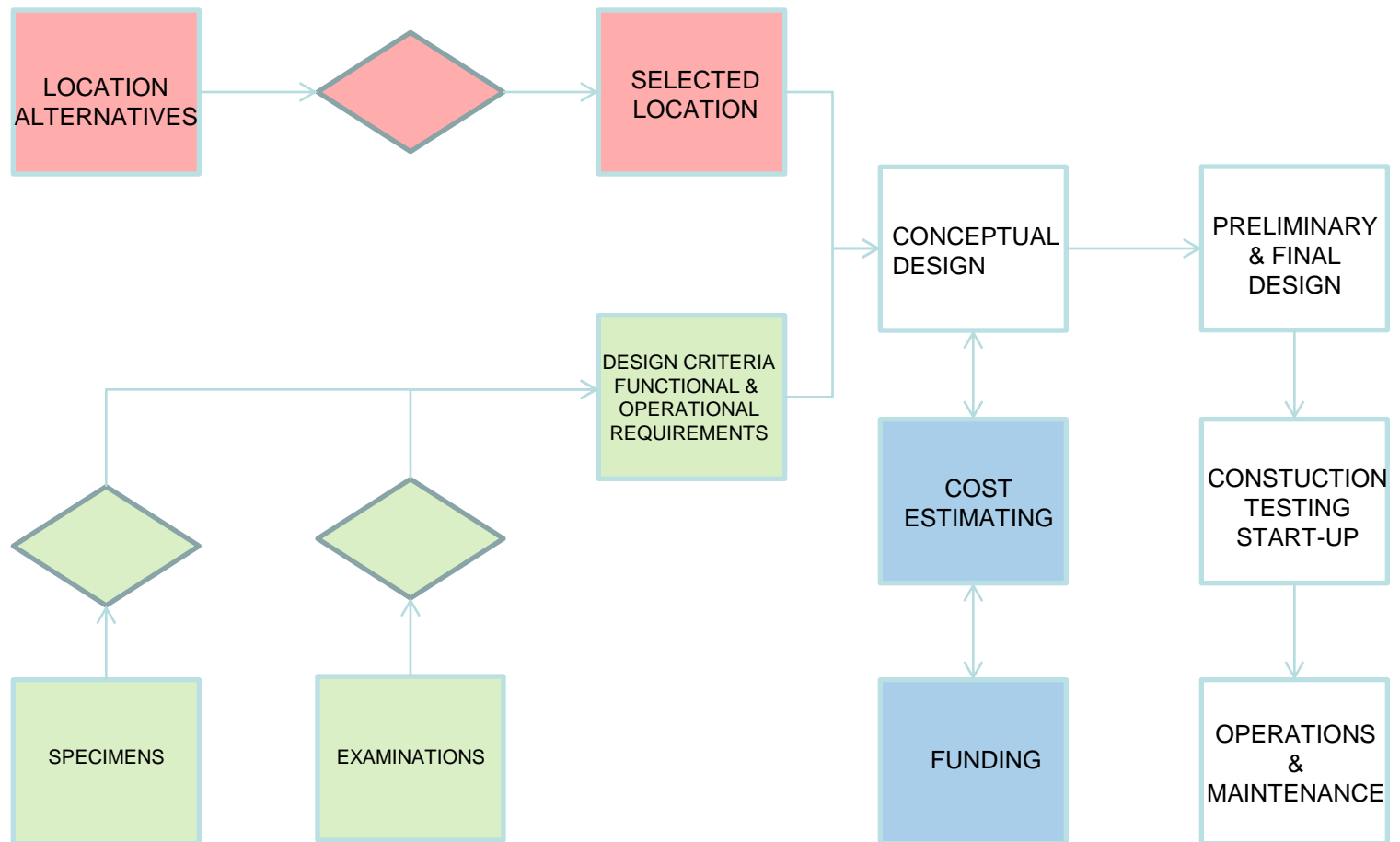
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# TYPICAL DESIGN STEPS

- 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



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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

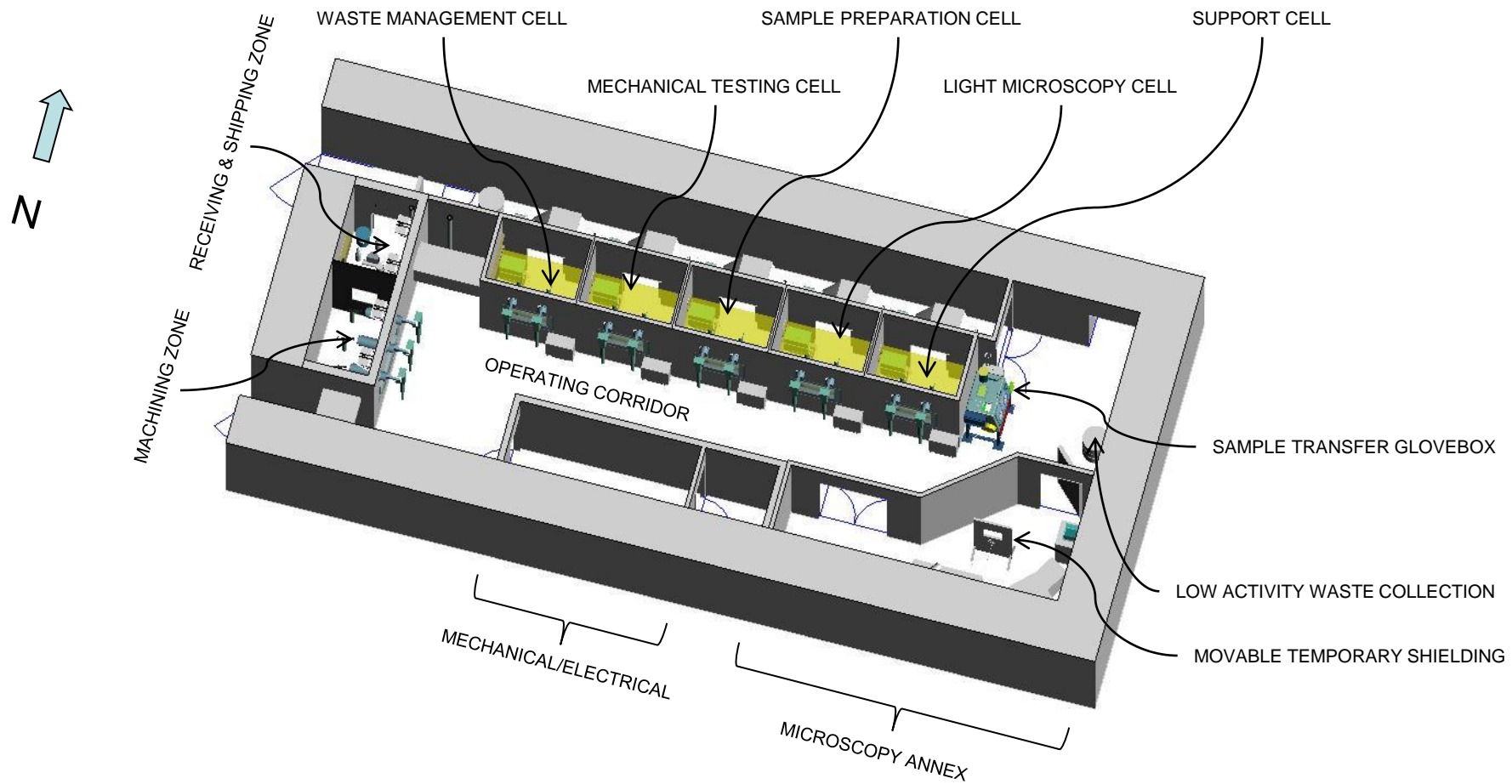


# ORIGINAL CONCEPTUAL DESIGN

- GIVEN THE CHALLENGES AND RESTRICTIONS DESCRIBED ABOVE, A CONCEPTUAL DESIGN WAS DEVELOPED
  
- REFER TO THE FOLLOWING SLIDE



# ISOMETRIC VIEW – LOOKING NORTH



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# ORIGINAL CONCEPTUAL DESIGN

- 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

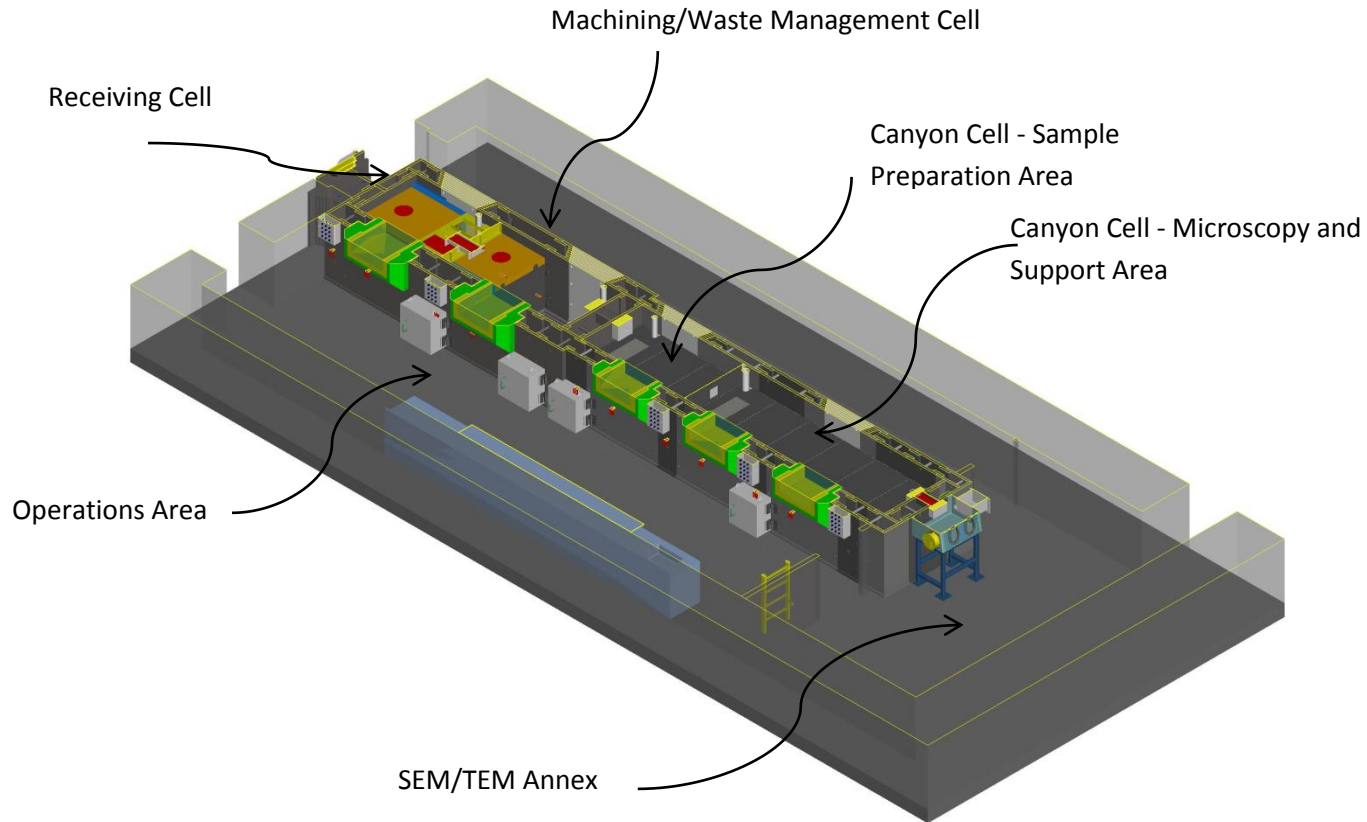
# NEW DESIGN APPROACH

- 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

# ADVANCED DESIGN SOLUTION

- 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



# 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

# ADVANCED DESIGN SOLUTION

- GENERAL HOT CELL FEATURES
  - SHIELDED 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

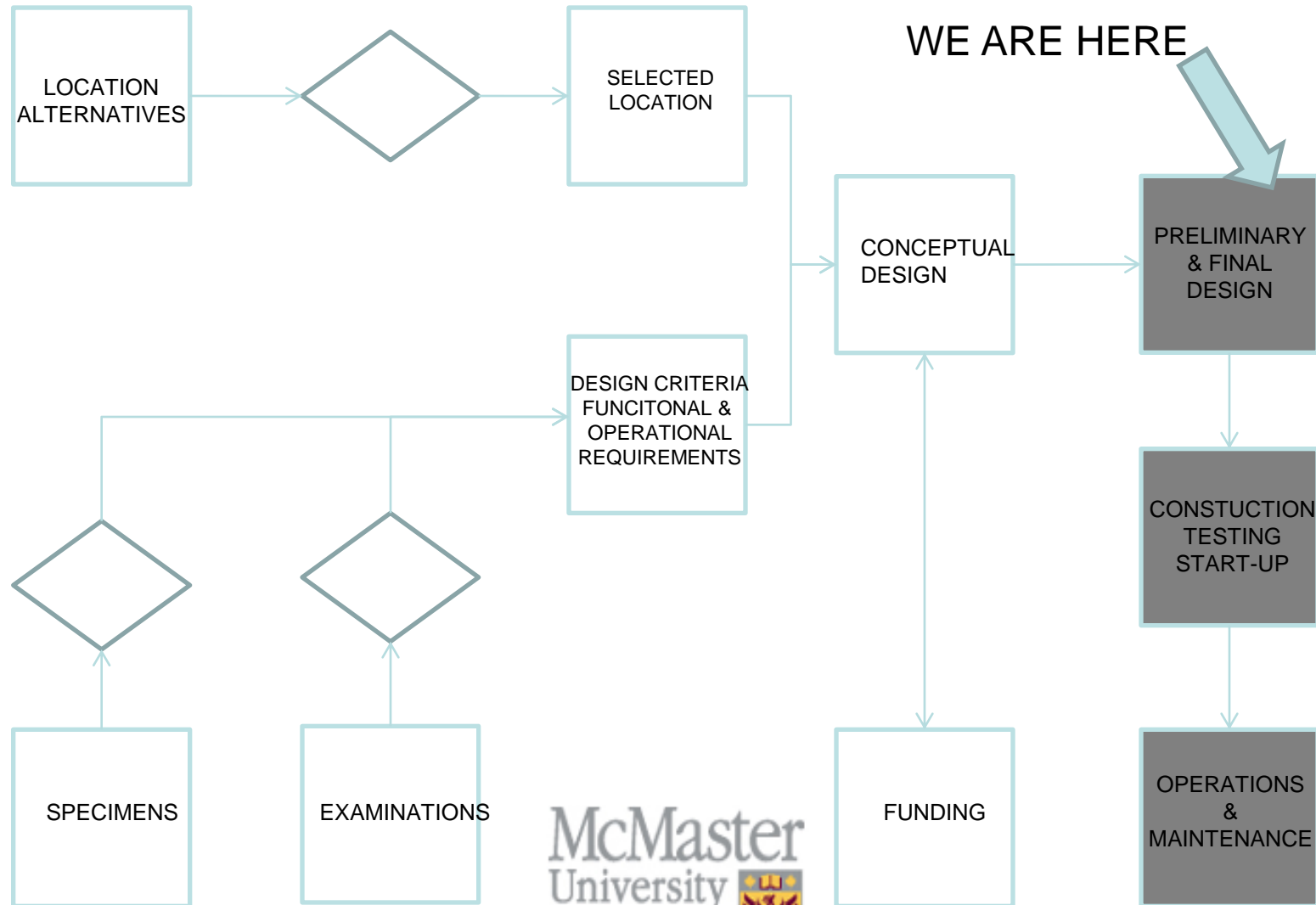
- ETCHING OPERATIONS HAVE BEEN MOVED OUTSIDE CELL TO A SHIELDED GLOVEBOX
  - PREVENTS ETCHING OF THE CELL WINDOW
- THE SEM/TEM AREA HAS BEEN RELOCATED TO THE EAST END OF THE FACILITY
  - THE AREA IS MORE EFFICIENT
  - EXPANDS THE RANGE OF MOVEMENT FOR THE OVERHEAD CRANE IN THE ROOM

# 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

# STATUS



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THANK YOU FOR YOUR TIME!

