MdL Generator System
Repair and Integration
By: Ishmeet Grewal, Nate Derry, Aaron Staib
Background

● 2 Diesel Generators are on-site at MdL
  ○ Not installed properly
  ○ Parts were missing or damaged
    ▪ Battery
    ▪ Fuel Lines
    ▪ Fuel Filter
    ▪ Oil Filter

● Electrical grid unreliable
Scope

- Deliver one integrated generator system to power critical appliances in kitchen.
  - Repair one generator
  - Install manual transfer switch
  - Connect system to MdL grid
  - Train staff to operate generator system
# Load Requirements

<table>
<thead>
<tr>
<th>Critical Appliance</th>
<th>Estimated Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Refrigerators</td>
<td>1542 W (total)</td>
</tr>
<tr>
<td>1 Freezer</td>
<td>1000 W</td>
</tr>
<tr>
<td>1 Microwave</td>
<td>1200 W</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3742 W</strong></td>
</tr>
</tbody>
</table>

*Generator Rating* | 5000 W
System Overview - Before

Main Power

Circuit Breaker Box

Other Circuits

Electric Stove

Old Fridge Three Sockets

New Fridge Microwave Freezer

Lights Fans
Proposed System Changes

- Generator
- Transfer Switch
- CB Box
- Refrigerators
- Microwave
- Freezer
- Other Appliances

Flow: Grid → Transfer Switch → CB Box → Project
Generator System Implementation

Troubleshoot and disassemble generator

Clean and reinstall components

Replace fuel system and battery

Replace housing, refuel

Replace exterior housing

Verification and testing

Install transfer switch to circuit breaker

Connect generator to circuit

Verification and testing

Training MdL staff
Repair Generator

- Disassembled both generators
- Found critical valve and fuel components
- Reverse engineered fuel system layout
Testing & Verification

- Cut and connect polyethylene fuel lines
- Siphon in diesel
  - Drain fuel
  - Fix leaks
- Start the generator
  - Verify 120V outputs
Testing & Verification

- Replaced all polyethylene fuel lines
  - More durable materials
  - Prevent further line failures
- Connected 240v plug to generator
  - Verified 2nd generator output
  - Primary output for our purposes
Install Wiring

- Drilled hole to run wire
- Measured necessary length for wire
- Installed wiring
- Connected NEMA plug
- Protected outside wire with conduit
Install Transfer Switch

- Installed between kitchen and dishwashing room
- Isolated necessary circuits
- Included safety locks
Testing & Verification

- Started the generator
- Discovered short circuit
- Tested individual circuits
- Fixed wiring
- System functional
Staff Training

- Prepared documentation for operating the system
- Staff followed documentation and started the generator with minimal guidance
- Saved the Ice Cream Activity!
System Overview - After

- Main Power
- Generator Power

- Other Circuits
- Electric Stove
- Circuit Breaker Box
- Transfer Switch
- Old Fridge Three Sockets
- New Fridge Microwave Freezer
- Lights Fans
Final Schematic
Deliverables

- Backup power capability for:
  - Two refrigerators
  - One freezer
  - One microwave
  - Three electrical sockets for small appliances
- One manual transfer switch rated for 100 amps
- One functional generator
- Troubleshooting and Operation documents, available in English and Spanish
- Generator Manual
- Staff Training
- Property layout sketches and video
Final Budget and Cost Analysis

Final Expenses: $408.99

Cost of Grid Power:
- $0.183/kWh

Cost of Generator Power
- $0.349/kWh

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Generator</td>
<td>$136.61</td>
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<tr>
<td>Transfer System</td>
<td>$214.18</td>
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<tr>
<td>Tools</td>
<td>$58.20</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$408.99</strong></td>
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</table>
Lessons Learned

- Stick to the plan
- Prepare for worst case scenarios
- Verify availability of ALL required supplies
- Take into account melting points of material
- Use data to your advantage
- The importance of documentation
Sustainability

- Powers kitchen during power outages
- Low usage cost vs. food perishing
- Can charge personal electronics

To Promote Sustainability the team:
- Demonstrated use to all MdL staff
- Provided documentation in English & Spanish
- Provided multiple copies of product manual
Recommendations for Future Teams

● **Generator Ventilation**
  ○ Construct and install a chimney to diffuse exhaust more effectively

● **Repair Second Generator**
  ○ Follow our designs to repair second fuel system
  ○ Install a second transfer switch to electrical grid
Summary and Conclusion

- Generator provides reliable backup power
  - Protect food, medicine, and communication
- Backup power is portable and scalable
  - More generators could be installed later
- Communication and Resourcefulness are key
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