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#4. Below deck storage system
will be chareedwith 2 million

te ofNG.

#2. Shore Storage will hold 4
million n3 or NG until Badger
needs

DTE NG supply Line

#1. The charging station will
compress the approximately 4
million ft3 of NG into storage.

#3. Charging line will fill the
below deck storage system

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1. Preliminary Design, Economics and Funding Options.
a. Boiler Retrofit from Coal Stoker to Natural Gas Burners and
Controls.
b. Shore Based Natural Gas Compressor and Storage System.
c. Onboard Compressed Natural Gas Storage System (Below Deck).

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2. U.S. Coast Guard Approval and Certification of Compressed Natural Gas Storage Below Deck (USCG and ABS).

3. Final Design, Contractor/Equipment Selection

4. Financing and Procurement

5. Below Deck Demolition/Site Preparation

6. Installation/Construction

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1. Boiler Retrofit From Coal to Natural Gas Burners.
• The conversion of the steam boilers from coal firing to natural gas
firing does not appear to present any significant physical
constraints or issues using land-based experience.

2. Shore Based Natural Gas Compression and Storage.
• DTE owns and operates NG filling stations and pipeline
compression throughout Michigan; The natural gas industry
operates compression and CNG throughout North America.

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1. On shore compressor and storage must accommodate cross lake service
busine._ss schedule; less than 2-hour fill time during peak summer season.

2. On board compressed· natural gas storage system below deck design and fit-
out.

3. Regulatory approval and certification of compressed natural gas storage for
maritime application below deck.

4. Project cost and financing/funding that supports operator's business plan

• Example of a CNG container unit under
evaluation

• Approximately 11 such containers
required to operate the SS Badger
storing 2 million cubic feet of
Compressed Natural Gas at 2,600 Psig.

• There are currently no U.S. Regulations
for the Storage of CNG Below Deck.

• U.S. Coast Guard approval may require
will significant time and effort.

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1. LNG is currently used to fuel some vessels
- Example: Washington ferry
2. Limitations on use of LNG
-Availability of CNG vs LNG in Ml and WI
3. USCG-approved CNG fueled ferry operates in VA
4. Need USCG approval for below deck CNG-storage
- IMO and ABS guidelines allow this
- 5. ABS evaluation - Status
6. Process for USCG review and approval for SS Badger

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1. Boiler retrofit from coal to natural gas burners.
• Typical industrial boiler design, installation and implementation hurdles.
2. Shore based natural gas compression and storage system.
• Design and operations must meet Ferry Operator's 1-2 hour time fill schedule
requirements.
3. On board natural gas storage system below deck.
• Design and installation challenging but not insurmountable.
4. Coast Guard approval of Compressed Natural Gas storage below deck.
• Represents one of the primary challenges to complete the conversion to clean
burning Compressed Natural Gas.
5. Project Funding
• Project must maintain viability of ferry operations in order to maintain jobs, and
benefit business and services within the local communities and states of
Michigan and Wisconsin.

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1. Eliminates use of coal in Lake Michigan cross lake operations

2. Could· be the first ship in world to operate boilers on CNG.

3. Certification of the use of CNG below deck in maritime operations establishes further application of clean burning natural gas in the shipping industry.

4. Maintains the viability of an American business, maintains jobs, supporting services and businesses in hard hit recession regions of Michigan and Wisconsin.

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