DTE Energy®

Energy Storage Common Issue Meeting: Ludington Pumped Storage Upgrade & Overhaul

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&

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DTE Energy overview

$924M - $980M
2017 operating earnings* guidance

Leader in **continuous improvement**

~$20B
market cap

Fortune 300
company

10,000
employees

Employees volunteered over **21,000 hours** to **300+ organizations** in 2016

Success tied to our **system of priorities**

Top quartile
in residential customer satisfaction for both DTE Electric & DTE Gas

Michigan's largest investor in and producer of **renewable energy**

* Reconciliation of operating earnings (non-GAAP) to reported earnings included in the appendix

Growth is driven by strong, stable utilities and complementary non-utility businesses

DTE Energy

75%-80% Utility

Growth driven by infrastructure investments aimed at improving customer reliability

DTE Electric

- *Electric generation and distribution*
- *2.2 million customers*
- *Fully regulated*

DTE Gas

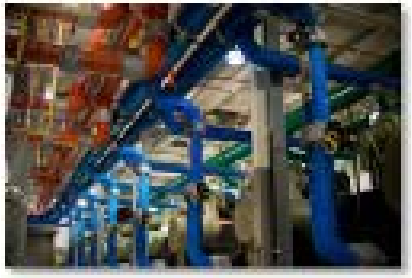
- *Natural gas transmission, storage and distribution*
- *1.3 million customers*
- *Fully regulated*

20%-25% Non-Utility

Growth driven by strategic opportunities

Gas Storage & Pipelines

- *Transport, store and gather natural gas*
- *5 pipelines, 91 Bcf of storage*



Power & Industrial Projects

- *Own and operate energy related assets*
- *68 sites, 17 states*

Energy Trading

- *Active physical and financial gas and power marketing company*

DTE earnings are 90-95% regulated or contracted

DTE Electric overview

$610M - $624M
2017 operating earnings* guidance

Founded
1886

2.2M
customers

$15.6B
2016 rate base

$8.4B
5 year capital plan
(2017-2021)

* Reconciliation of operating earnings (non-GAAP) to reported earnings included in the appendix

Ludington Pumped Storage Upgrade & Overhaul

Presentation content was taken from a presentation originally prepared by

Keith Toro, Lead Engineer

Consumers Energy

Agenda

- **Explain intent behind DTE's Energy Storage issue submission form**
- **Provide history of the Ludington plant**
- **Describe how Ludington participates in the MISO market today**
- **Propose rule changes that could increase the value of pumped storage assets to MISO in the future**

DTE submitted the ES issue submission form to increase the value of pumped & energy storage assets to MISO and …

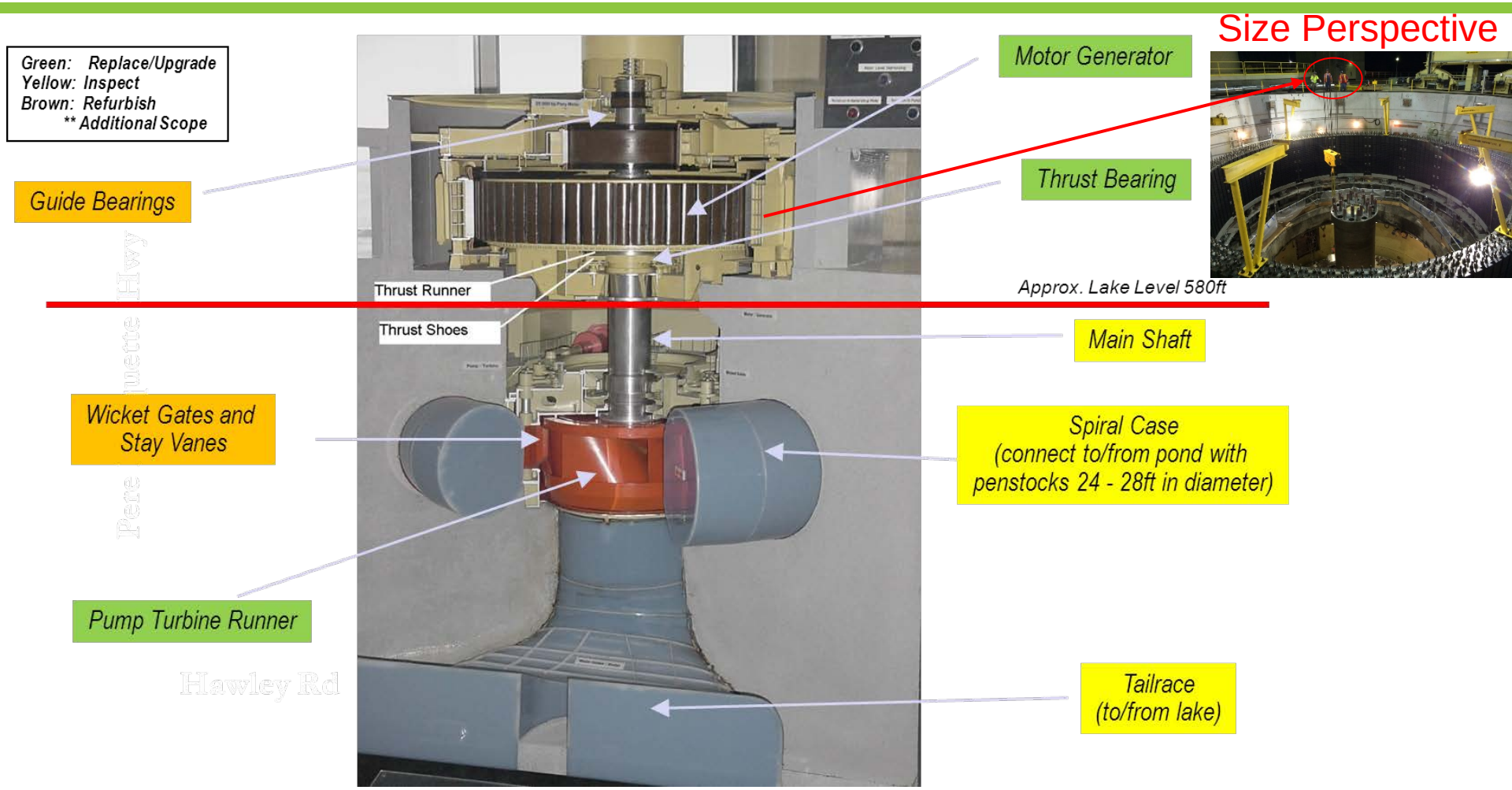
Ludington Pumped Storage Viewed Looking East

... to have MISO fully leverage existing assets while enhancing the market to accommodate future ones

- **Pumped storage is essentially a big battery (~2,300 MWs)**

Mason County - Where Energy, Economy, and Environment Meet

Ludington is 1,872 MW in total and when the upgrade project is complete the nominal output is expected to be about 2,300 MW



Ludington Unit Model Showing Equipment Being Upgraded

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Construction began in 1969 and completed in 1973 at a cost of $327 million (1973 dollars)

- The plant is co-owned 51% by Consumers Energy, 49% by DTE Energy
- Initial site investigation began in 1959, with a conceptual design completed in 1961
- Ludington was the largest pumped storage plant in the world (by MW) at the time
- In 1973, Ludington was the ASCE National Civil Engineering Project of the Year

Ludington Pumped Storage Plant Facts

- Ludington's man-made reservoir is 2.5 miles long and 1 mile wide encompassing 842 acres. It can hold 27 billion gallons of water, of which 17 billion gallons are usable for generating electricity
- There are 6 reversible pump turbine units at Ludington, each capable of either pumping or generating
  - When in pump mode, the units are physically the largest motors in the world, capable of approximately 525,000 horsepower (double the power of a Nimitz-class aircraft carrier)
  - The flow rate for each unit is 5.5 million gallons per minute (about 100,000 gallons per second) or 33 million gallons per minute in total
  - The original units were built by Hitachi. The ongoing upgrades are Toshiba

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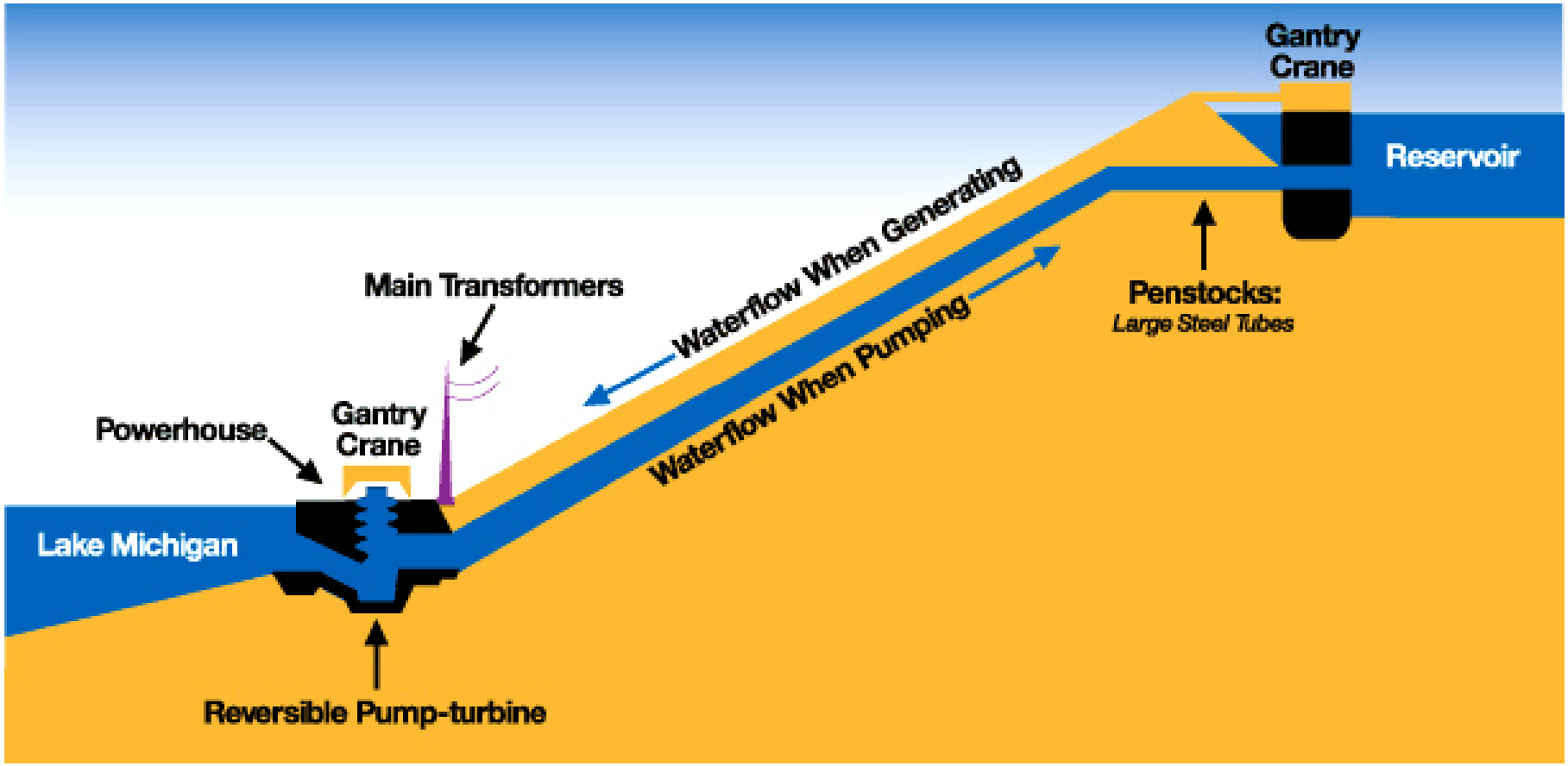
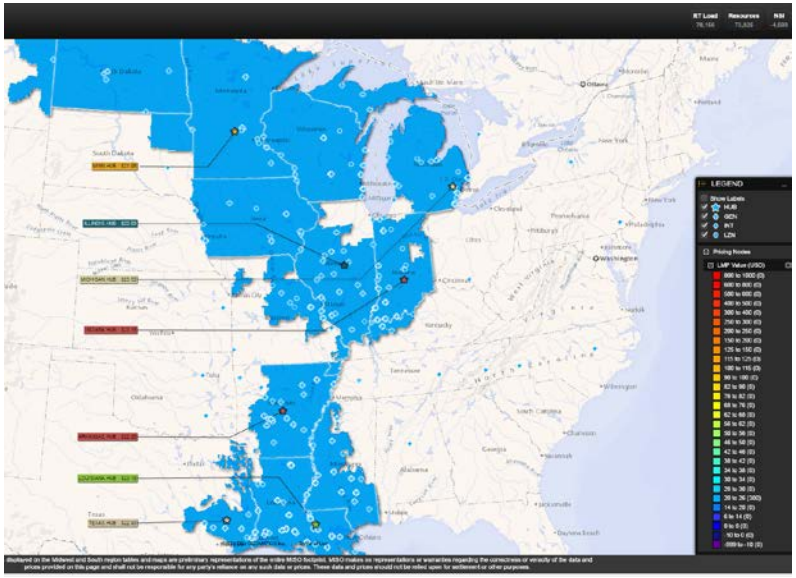
During the day, the reversible pump-turbines generate electricity as water is released from the reservoir. At night, the reservoir is replenished using lower cost off-peak power



It takes about 10 hours of pumping to provide about 8 hours of full Plant generating capacity

Ludington provides economic benefit to its customers by providing capacity benefits in the market, capturing the arbitrage of the on and off peak energy market prices, and providing ancillary services in the market such as regulation and contingency reserves



MISO LMP Contour Map

- The Midcontinent Independent System Operator (MISO) optimizes and dispatches Ludington's generation based on its energy limited resource offer 1 day at a time
- MISO currently does not optimize Ludington's pumping schedule since current resource types cannot be modeled both as a generator and a load
- Market Participants can submit virtual day-ahead (DA) demand bids so the market can account for the pumping load in real-time
- Further market benefits could occur if MISO were to optimize over a 7 day period for both the generation and pumping cycles of Ludington

Ludington Pumped Storage Plant has many grid benefits including support of intermittent variable resources

- Ludington generates ~1,500 GWhs and pumps ~2,000 GWhs annually
- Ludington units have fast start capability and can be on line in 3 minutes
- Ludington units support intermittent/variable resources
- Ludington can provide grid supply regulation for Michigan/MISO
- Ludington can also provide spinning and supplemental reserves for Michigan/MISO

Lake Winds Energy Park
Wind Turbines

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Having the capability to model assets as both generation and load sources over an extended period of time could provide MISO's load value

- Model resources as both generation and load assets in the market, planning, and reliability processes
- Optimize generation and load cycles for resources beyond 1 day (e.g. ~7 days)
- Provide MISO the ability to better leverage a flexible source or sink of energy for operational or reliability reasons
- With MISO's efforts in the Market System Evaluation, the time is now to fully leverage these assets to benefit MISO's members and their customers.

Stator Build

Questions?

Thank You!