Williston Basin **Breakthrough Technologies**

Davis Refinery

The Davis Refinery: *Industry Proven Technology, Comprehensively Applied to Meet Lower Emissions* with Lance Medlin, *EVP Projects, Meridian Energy Group, Inc.*

Williston Basin Petroleum Conference 2018

Meridian Energy Group Inc.

The Meridian – Davis Refinery Project

- ❖ The Davis Refinery, a Full-Conversion crude refinery in the Bakken
  - 300,000 bpd of Bakken crude produced in nearby 4-county area – best crude in the world
  - Site was Rezoned & Use Permit Approved July 6th, 2016
  - Site has excellent logistics access
- ❖ Davis Initial Phase
  - 27,500 barrels per day ***("bpd")*** hydro-skimming plant, full commercial operation in early 2020
  - Produces finished gasoline, Kerosene/Jet-A, Ultra Low Sulfur Diesel, Low Sulfur Fuel Oil (ATBs)
  - Construction will begin after air quality permit is awarded
- ❖ Davis Expansion
  - Plans to expand Davis up to 49,500 bpd
  - Design will be based on operating results from initial phase

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Davis - Logistics

- Davis Refinery Site Advantages Include
  - Excellent road transportation infrastructure
  - Access to oil and gas pipelines, gathering systems and terminals
  - Excellent right-of-way access for enhancing product pipeline capabilities

Fryburg Rail Terminal

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Davis – Synthetic Minor Source Makes History

- The innovative design of Davis will achieve emission rates so low that it has qualified as a Synthetic Minor Source by the NDDoH – Air Quality Division.
  - First time in the history of refining a project of this complexity permitted as a Synthetic Minor Source
- Ultra – Low NOx Burners (ULNB)
  - Installed in all boilers and heaters
- Selective Catalytic Reduction (SCR)
  - Standard for the largest fuel gas combustion devices within the plant
  - Selective Catalytic Reduction (SCR) for post-flue gas treatment to reduce NOx emissions
  - Reduction to single – digit ppm levels
  - NOx reductions up to 95 percent

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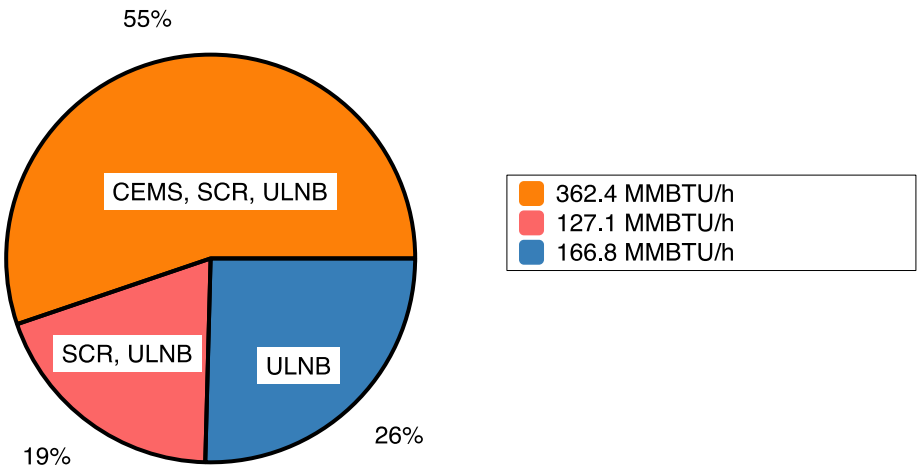
Davis – Synthetic Minor Source Makes History

- Superior approach to emissions control
- All heaters and boilers have at least one control technology
- 74% of the heaters and boilers have two or more control and monitoring technologies



Total Thermal Capacity: 656.3 MMBTU/h

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Davis – Innovative LDAR Monitoring

- The Davis Refinery will be truly unique in its comprehensive utilization of emission control technology throughout the plant.

- Highly-advanced Enhanced Leak Detection Monitoring and Repair (ELDAR)
    - *Front End Engineering Design* (FEED) elimination of open lines and difficult to monitor components
    - Highest standards in the selection of materials of construction for gaskets and seals to approach leak-less status
    - Use of Optical Gas Imaging in conjunction with Method 21 detectors
    - OGI will be complemented with a QL320/QL 100 series processor to determine ppm-m/h readings
    - ELDAR Level 5 program philosophy:
        - Proactive maintenance of bad actor components rather than the reactive detect and repair
        - Approach continuous monitoring through OGI
        - LDAR ultrasonic survey of valves to prevent leak-by to flares

Davis – Optical Gas Imaging (OGI)

- Optical Gas Imaging (OGI) cameras, a maximum available monitoring technology to detect VOC leaks.
- OGI camera allows a greater of components monitored/day in comparison to Method 21 alone
- OGI cameras use the property of infrared light absorption by VOC to detect leaks
- Complements the inspection of petroleum storage tank seals and vents, compressor operations, and heater tube/fire boxes
- The U.S. EPA has identified OGI as the ***"best system of emission reduction"*** for detecting fugitive emissions from new equipment installation, upgrades, and modified sources.

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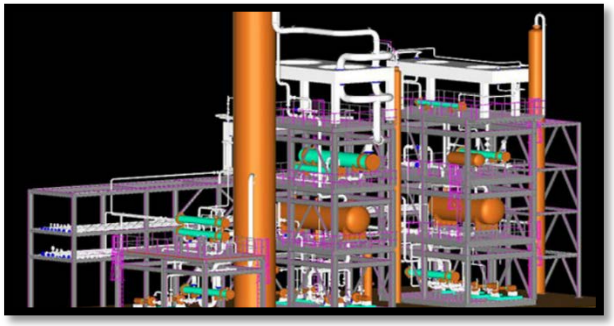
Davis – Enclosed Flaring Control

- Innovation and significant advances in technology will enable the Davis Refinery to regularly operate without any significant external flaring
  - The NDDR vapor recovery unit will recycle liquids and vapors back to the units rather than to flaring
  - Only streams exceeding the capacity of the VRU will will be sent to the enclosed flare as part of the minimization of flaring

- A noticeable distinction between Davis and refineries utilizing legacy technology will be the minimization of use of flares
  - Flare stacks, a common component of older plants, are primarily back-up systems in a modern, greenfield refinery.
  - Historically, during plant or partial plant startups and shutdowns, flare stacks were used for the planned combustion of gases over relatively short periods.
  - Flare stacks are also for the unexpected combustion of emergency relief gases.



Courtesy of Vepica USA

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Flaring Continued - Vapor Recovery Systems

- Through state-of-the-art Vapor Recovery Systems, Davis will capture gases and recycle them for use in running its heater and boiler systems.
  - During operation, the Davis Refinery vapor recovery system is the primary system designed to capture all relief flows, with the enclosed flare as its backup.
  - If needed, the flare stack will be employed.

- The Davis design is unique in that the backup flare stack system, which is the main disposal mode in older refineries, is there merely as a secondary backup system.

- Older Refineries do not usually have enclosed flares or refinery wide Vapor Recovery Systems
  - Typically send relief flows directly to flare stacks as a part of normal operations.
  - Davis flaring will only operate in the event of upsets or malfunctions to the enclosed ground-level flare.

Courtesy of Vepica USA

Davis – Designed to Meet the Lowest Achievable Emission Rates (LAER) in the Industry

- First High-Conversion Refinery to qualify as a Synthetic Minor Source
- The First Complex Refinery built in the US in 40 years (Tesoro Dickinson Refinery built in May 2015).
- The Cleanest Refinery on the planet when complete
- Enhanced Leak Detection and Repair Monitoring
- Staged Relief System including Vapor Recovery and Enclosed Flaring
- Secondary Seals on all Product Storage Tanks and Rotating Equipment

Permit to Construct Issued by North Dakota Department of Health – Air Quality in May 2018!

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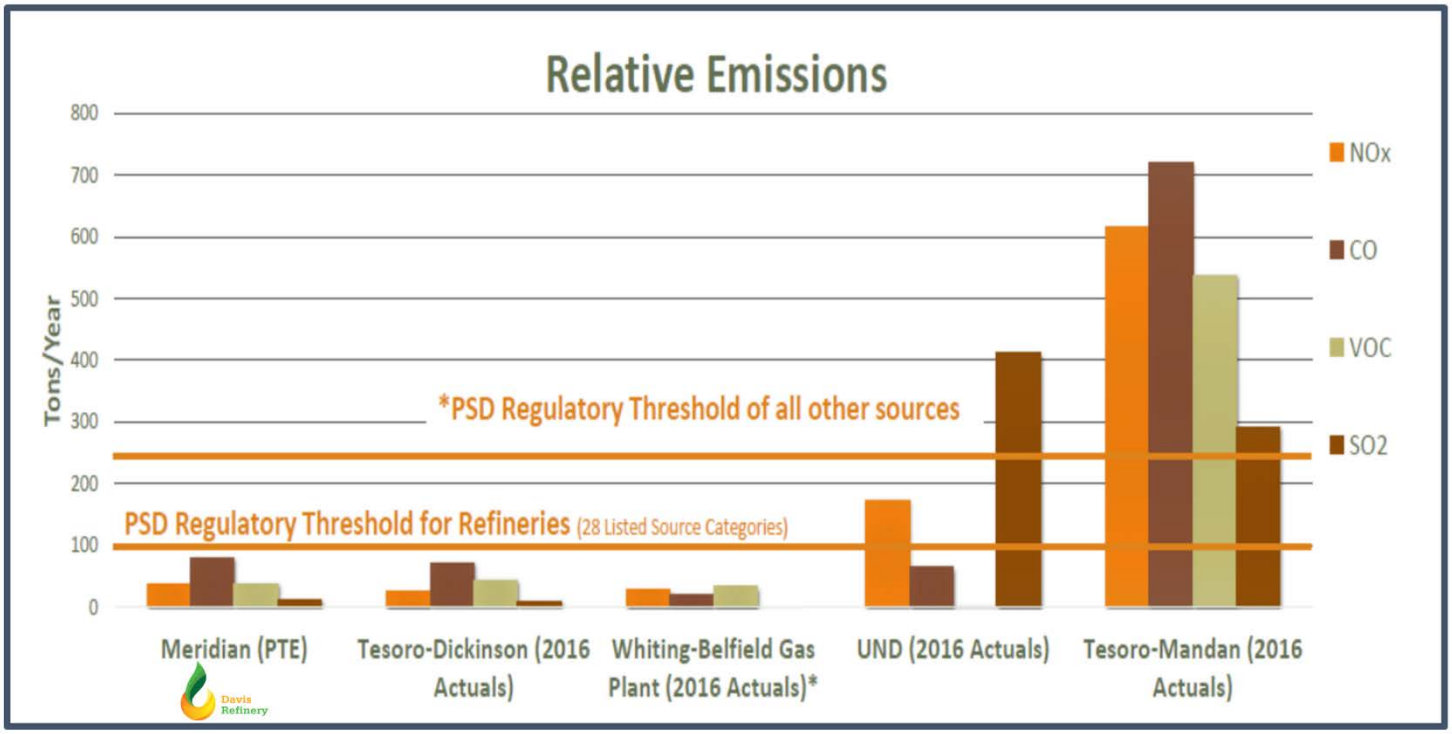
Davis – North Dakota Emission Comparisons

NORTH DAKOTA DEPARTMENT of HEALTH



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Davis – Estimated Emissions at full production

- ZIA Environmental Engineering estimated the tailpipe emissions from the more than 600,000 visitors to the Theodore Roosevelt National Park using traffic count data publicly available from the Park Service website.
- The table does not consider traffic on I-94 from other than visitors to the Park.

			Vehicle Miles Traveled by Type (VMT)				Emissions, Ton per year (TPY)			
Year	Traffic Count	Total Miles	LDG	HDG	HDD	MOT	HC	CO	NOX	PM Tot
2017	111,289	2,003,202	1,502,402	260,416	200,320	40,064	80	1,039	359	359
2016	107,850	1,941,300	1,455,975	252,369	194,130	38,826	78	1,007	348	348
2015	89,929	1,618,722	1,214,042	210,434	161,872	32,374	65	839	290	290
2014	86,545	1,557,810	1,168,358	202,515	155,781	31,156	62	808	279	279
2013	88,637	1,595,466	1,196,600	207,411	159,547	31,909	64	827	286	286
Estimated Emissions From Meridian Refinery at Full Production (Phase II)							61.63 (as VOC)	79.6	38.95	12.99

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zia engineering & environmental consultants, llc

Davis – Vehicle Emission Comparison TRNP

Theodore Roosevelt National Park

Average (2013-2017)		Emissions, Ton per year (TPY)			
Traffic Count	Total Vehicle Miles	Hydrocarbons (as VOC)	CO	NOX	PM Tot
96,850	1,743,300	70	904	313	313

Estimated emissions from Meridian Refinery at full production (Phase II)

North Dakota Davis Refinery

Emissions, Ton per year (TPY)			
Hydrocarbons (as VOC)	CO	NOX	PM Tot
62	80	39	13

- Zia Engineering & Environmental estimated the vehicle emissions from the 2013-2017 traffic to the Theodore Roosevelt National Park using data publicly available from the Park Service website.