



Sampling Program to Characterize Gulf of Mexico Produced Water Oxygen Demanding Materials

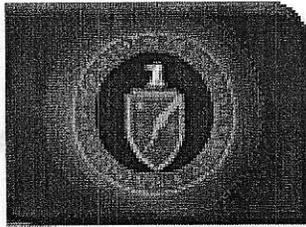
Presented by John Veil
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Washington, DC

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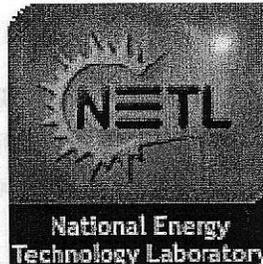
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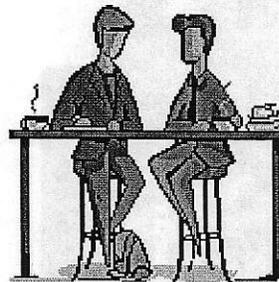


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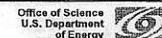
Topics for Discussion

- Overview
- What is produced water?
- What is oxygen demand and the hypoxic zone?
- Why is produced water being sampled?
- Who are the players?
- How is the sampling program being designed and implemented?
- What is the schedule?



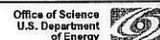
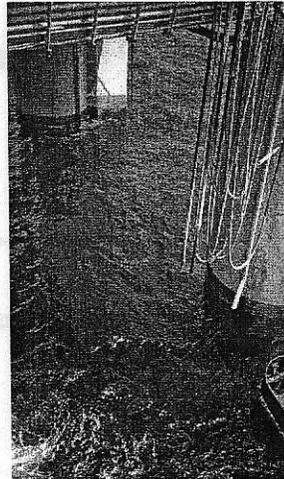
Overview of Sampling Program

- During the first few months of 2005, Argonne National Laboratory will coordinate a program to sample produced water from 50 offshore platforms
- The purpose of the sampling program is to characterize the contribution of produced water to the hypoxic (low oxygen) zone in the Gulf of Mexico
- This presentation explains the details of the sampling program



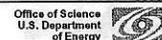
What is Produced Water?

- Water that comes to the surface with oil and gas
- Contains many chemical constituents
 - Salt content (salinity, total dissolved solids [TDS], electrical conductivity)
 - Oil and grease
 - *Composite of many hydrocarbons and other organic materials*
 - Toxicity from various natural inorganic and organic compounds or chemical additives
 - NORM
 - Some oxygen demanding materials



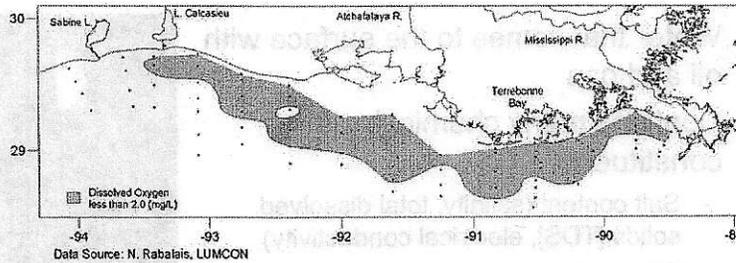
What Is Oxygen Demand?

- The amount of oxygen that is consumed through microbial biodegradation of materials in a water sample
 - Typically measured as biochemical oxygen demand (BOD₅)
 - Can be caused by many chemical constituents
 - *Carbon*
 - *Nitrogen*
 - *Phosphorus*
- High oxygen demand can deplete oxygen in surface or bottom waters
 - Creates an unhealthy environment for marine life



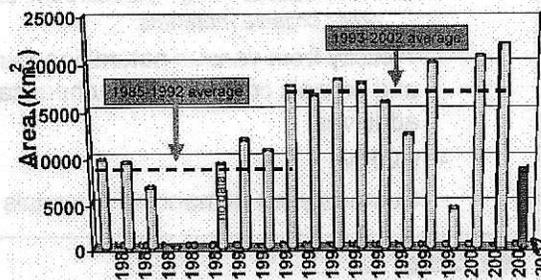
How Does This Affect Offshore Oil and Gas?

July 21-25, 2004 - Area of Bottom Hypoxia



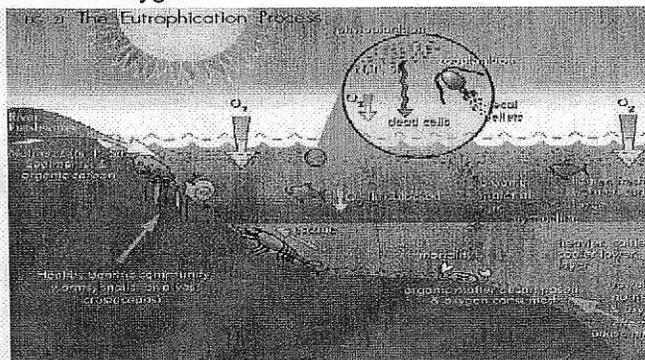
- Each year, a large hypoxic zone forms in the near-shore Gulf of Mexico
- Size of zone appears to be increasing

Areal Extent of Hypoxic Zone 1985 - 2003



How Is the Hypoxic Zone Formed?

- Primary contribution to hypoxic zone is nutrient inputs from Mississippi River and Atchafalaya River
 - Other sources may be important too
- Nutrients cause rapid growth of phytoplankton
- Later these die off and sink to the bottom where they are decomposed by microorganisms
 - This depletes the available oxygen

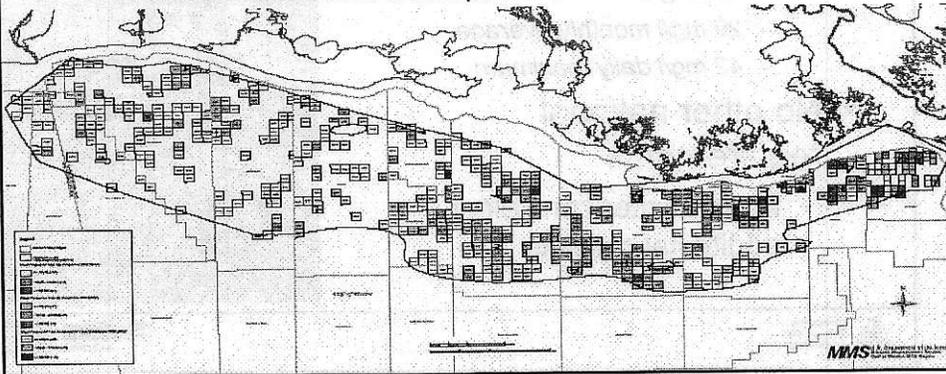


Source: NOAA



Why Is Produced Water Being Sampled?

- Numerous offshore produced water discharges enter the hypoxic zone
 - The red line outlines the zone that experiences <math>< 2\text{ mg/l}</math> oxygen more than 25% of the time – our study area
- EPA is concerned that offshore discharges make a significant contribution to oxygen demand
 - The offshore contribution is not quantified

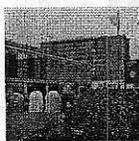


U.S. Regulatory Requirements for Discharging



Laws

- Clean Water Act



Discharge Regulations

- National Pollutant Discharge Elimination System (NPDES) program
- Effluent limitations guidelines (ELGs)



Permits and Guidance

- Environmental Protection Agency (EPA) or delegated states issue NPDES permits for discharges



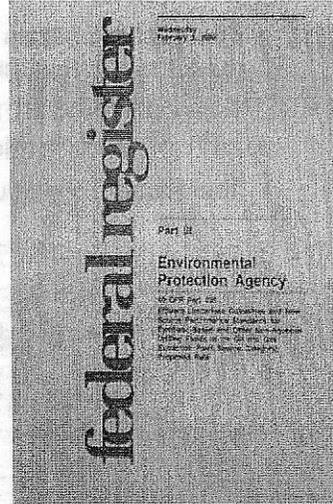
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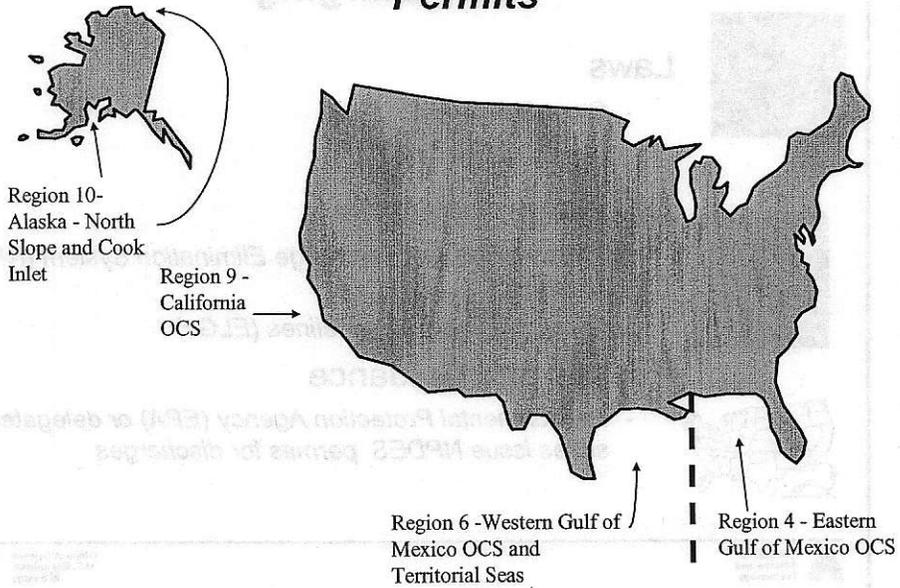


Offshore and Coastal ELGs

- Best Available Technology (BAT) for offshore produced water:
 - Oil and grease limits before discharge
 - 29 mg/l monthly average
 - 42 mg/l daily maximum
- No other national requirements
 - Permit writer can select additional controls

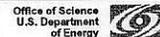


EPA Regions Issuing Offshore General Permits



EPA Actions

- EPA began work on renewing permit for OCS in central and western Gulf in 2003
- Proposed permit conditions include language to control produced water oxygen demand inputs:
 - New or increased produced water discharges to the hypoxic zone would be prohibited unless a comparable amount of BOD is removed from other produced water discharges
 - Proposed a web-based trading program



EPA Actions - continued

- Industry and MMS strongly objected to this during winter and spring 2004
- EPA agreed to remove the proposed conditions and require an industry sampling program
 - All discharges located in hypoxic zone would sample individually or the industry could undertake a joint study
- Permit was issued for 3 year-term rather than the usual 5 years
 - Would allow for the permit to be renewed following collection of new data



The Players and Their Roles

EPA – Issued permit; will decide future regulatory actions based on the study results

API – funding the laboratory analytical work

MMS – Responsibility for offshore activities; maintains extensive data collections and sponsors research

Offshore Operators Committee – assisting with selection of sampling locations; many member companies will be sampled

DOE – Concerned about maintaining energy supplies from offshore production; funded sampling program support

PERF – recommended that DOE fund the produced water sampling study

Argonne – DOE contractor; designed sampling program; will coordinate sampling and interpret results

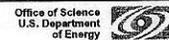
Two analytical laboratories – one will coordinate preparation of sample kits and delivery of samples to second lab; second lab will conduct tests

Goals of Sampling Program

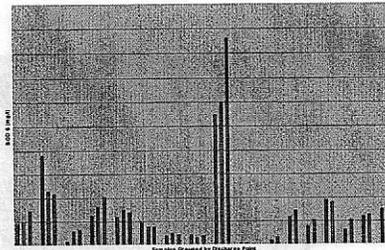
- Sample approximately 10% of the discharges in the study area
- Determine average and range of BOD and nutrients from produced water discharges
- Estimate variability within the same discharge
- Follow good scientific procedures
- Complete study by August 2005

Activities to Date

- **Summer of 2004** – DOE funded Argonne to conduct study
 - Argonne began working with industry to develop draft sampling plan
- **Aug 2004** – meeting of all stakeholders to establish goals
- **Sept 2004** – meeting with water quality modelers to identify the sampling parameters needed model inputs
- **Oct-Nov 2004** – developed sampling plan
 - several rounds of review and comment
- **Dec 2004** – final sampling plan approved; developing QA/QC plan; selecting sites for first round of testing



Number of Sites to Be Tested



- EPA requested samples from 50 sites
- The agreed-upon composite sampling program
 - 35 sites are sampled once
 - 15 other sites are sampled 3 times
 - addresses internal variability and consistency
 - If first 3 samples do not show enough consistency (criterion to be determined later), 4th, 5th, or 6th sample will be taken
- Issue
 - BOD is a space-intensive test
 - Larger numbers of samples might overwhelm laboratory



Selection of Sampling Sites

- For the 15 sites tested 3 times, subdivide leases into 3 water production rate classes (< 500 bbl/day, 500 – 5,000 bbl/day, >5,000 bbl/day) and 3 hydrocarbon production type classes (oil completions, gas completions, both types of completions)
 - Select at least 1 facility from each of the 9 subcategories
- For the 35 sites tested one time, select locations at random
- Issue
 - Neither EPA nor MMS has accurate data of number and identify of produced water discharges
 - Decided to use MMS data on leases that produce both water and oil or gas (496 leases in study area)

Parameters to Be Sampled

Measure Direct Oxygen Demand

BOD
TOC (total organic carbon)

Other Parameters

pH
conductivity
salinity
temperature

Measure Indirect Oxygen Demand

ammonia
nitrate
nitrite
total Kjeldahl nitrogen (TKN)
total phosphorus
orthophosphate

Sample Collection and Transportation

- Sample kits will be delivered to shore bases in advance of sampling date
- Platform personnel will collect samples according to instructions and place them in a cooler with ice
- Cooler will be taken to helicopter pilot who will deliver to shore base
- Laboratory representative will collect cooler at shore base and deliver to lab
- All transfers will be documented on Chain of Custody form
- Issues
 - Tests must be started within 48 hours of sample collection
 - Complex scheduling and coordination
 - *Weather could impact schedule*



QA/QC

- QA plan will be developed before sampling begins
 - Sampling measures
 - *Blanks*
 - *Duplicates*
 - Analytical measures
 - *Calibration*
 - *Matrix samples*
 - *Blanks*



Planned Schedule

- Jan-Feb 2005 – complete selection of sites for sampling; start first round of samples
- March-May 2005 – second and third round of samples
- March-June 2005 – receive and review lab results; take additional samples to improve variability, if necessary
- May-July 2005 – analyze data and prepare draft report
- July-Aug 2005 – stakeholders review draft report
- Aug-Sept 2005 – prepare final report (may need additional rounds of review and revision)



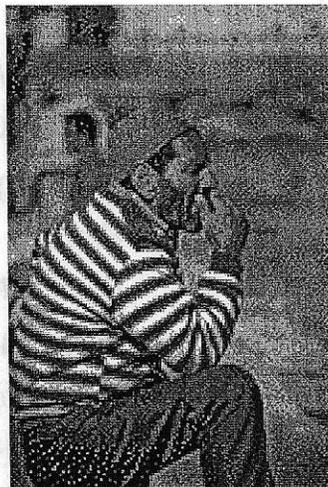
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Conclusions

- Designing sampling program has been a cooperative effort among many players
- Sampling will begin soon
- Program is complex but must be done in short time frame to meet EPA needs
- Results must be scientifically sound as they will be the basis for future regulatory decisions



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