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OSHA Exposure Assessment Onshore and Offshore in the Deepwater Horizon Oil Spill Response

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OSHA Occupational Safety and Health Administration

OSHA Activities

- Ensure that workers have safety and health training and protection necessary to avoid injuries and illnesses
  - Technical Assistance to UC and Agencies
  - Conduct Interventions
  - Develop and implement exposure assessment and sampling strategy

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OSHA Worker Exposure Assessment and Sampling Activities

- Information collected on employers, workers, and work tasks (standard form)
  - Hazards
  - PPE
  - Controls

- Sampling Strategy
  - Three (3) work zones
    - Onshore
    - Near shore
    - Offshore
  - Sixteen (16) specific work tasks

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Sampling Tasks

1. Manual scraping
2. Sump and pump/vacuum
3. Manual removal of oil materials
4. Low pressure flushing
5. Manual sorbent application
6. Manual cutting
7. In-situ burning
8. Vacuum truck, vacuum pumps, portable skimmers
9. Oil mop
10. Recovery of oil from groundwater
11. Marsh-non shore cleanup operations (SCAT)
12. Skimming
13. High pressure cleaning
14. Manual removal of solid tar balls
15. On shore support
16. Float support

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Developing the Sampling Strategy

- Data from previous incidents
  - Consultation with SLTC Laboratory
- Data from this incident
  - Crude Oil Vapors
  - Weathered Oil
  - Headspace Analysis of Bulk Samples
  - Air Chemistry (NOAA)

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Preliminary Sampling Data
Crude Oil Vapors

- SUMMA canister sampling of “fresh” crude oil vapors at spill site
- Samples taken directly above the oil surface and also on vessel surfaces
- Most substances were non-detectable
- Detected substances: 2-400 ppbv
- Concentrations were lower at vessel deck level compared to water surface
- Water soluble compounds go into solution (> 1 mile of seawater)
- Less soluble, smaller MW compounds rapidly volatilize into atmosphere

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Preliminary Sampling Data
Weathered Oil

- Samples analyzed by two separate laboratories
- Lower MW hydrocarbons were non-detectable (BTEX, etc.)
- Lowest MW hydrocarbon detected was C14
- Naphthalene was detected using more sensitive method at 0.1 mg/kg oil (just above the detection limit)

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Bulk Headspace Analysis

- Used qualitative mass spectrometry to evaluate volatiles in bulk samples of weathered oil
- At 80^{o}C (176^{o}F) no volatiles were detected in headspace
- Test re-run at 120^{o}C (248^{o}F)
  - C14 to C23 were major components of headspace
  - Minor components included C-6 to C-10 compounds
  - Demonstrated that volatile compounds were not expected to be released from weathered oil

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NOAA Air Chemistry Sampling

- OSHA partnership with NOAA to conduct air chemistry sampling
  - P3 aircraft
  - NOAA vessels
    - Air Canisters
- Confirmed OSHA sampling strategy (qualitative basis)

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Compounds Monitored

- Chemical Exposure Assessments
  - Oil
  - Dispersants
  - Cleaning agents
  - Combustion products
- Physical Hazard Assessments
  - Noise
  - Heat

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Sampling Methods

Sample	Method	Media	Comments
VOC-Diffusive (BTEX, etc.)	OSHA 1005	SKC 575-002 Diffusive Sampler	Crude oil
VOC-Active (BTEX, etc.)	OSHA 1005	SKC 226-01 Charcoal Tube	Crude oil
Petroleum Distillates	OSHA 48	SKC 226-01 Charcoal Tube	Crude oil
Heavy Aliphatics & Aromatics	Qualitative GC/MS	SKC 590-100 Ultra I Sampler	Crude oil
Propylene Glycol	OSHA PV2051	SKC 226-57 XAD-7 OVS Tube	Dispersant
2-Butoxyethanol	OSHA 83	SKC 575-002 Diffusive Sampler	Dispersant (prior to 5/2010)

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Sampling Methods
(continued)

Sample	Method	Media	Comments
Formaldehyde	OSHA 1007	Assay Tech ChemDisk	In-situ burning
Oil Mist	PC2121	PVC Filter	Decon/pressure washing (initial sampling)
Glycol Ethers (2-butoxyethanol)	OSHA 83	SKC 226-01 Charcoal Tube	Decon cleaning agent
Benzene Soluble Fraction	OSHA 58	Glass Fiber Filter	Decon/pressure washing

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Direct Reading Methods

- VOC: Photo-ionization detector (PID)
- 4-gas: CO, H2S, %LEL, %O2
- Benzene, Toluene, Xylene, TPH, NH3: CMS/Detector Tubes
- Noise: SLM, Dosimeter
- Heat Stress: WBGT Meter

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Coordinated IH Effort

- Tasked to perform 3rd party/verification sampling of spill response operations
  - OSHA Health Response Team
  - Regional and Area Office Staff
- Daily coordination meetings with IH Technical Leads
  - Resources are limited
  - NIOSH, USCG, OSHA, EPA, BP and Contractors
  - Response to complaints or incident reports
  - Excursions
  - Operations
- Did not necessarily use same sampling and analytical methods between Agencies

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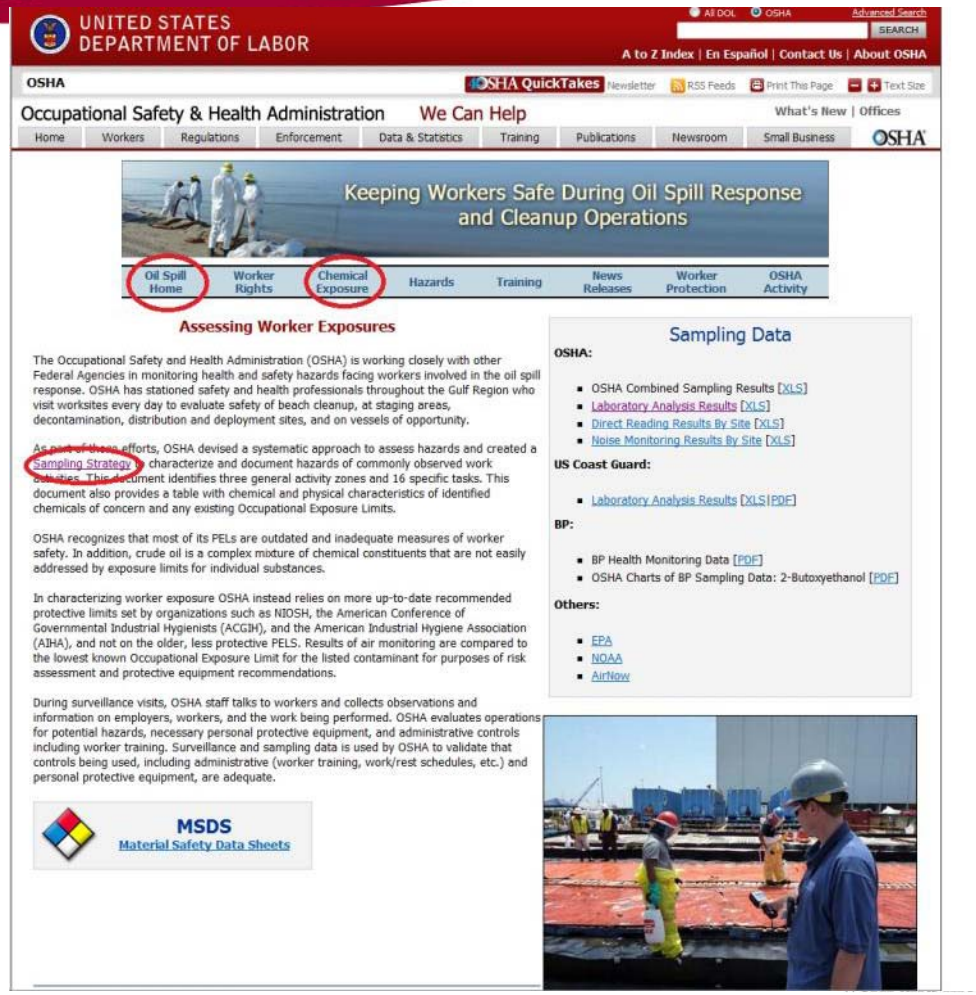
Where to Find the Data?

- OSHA and USCG Data
- Sample Types
  - Personal
  - Area
  - Direct Reading
  - Integrated (Laboratory Analysis)
- Compared to lowest OEL



OSHA Sampling Summary

Operation	Air Sample Results
Shore Cleanup	2032
Vessel Booming and Skimming	2490
In Situ Burn	95
Decon	3773
TOTAL	**8390**

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Reporting Limits (RL)

- Reporting limit is the mass of an analyte that the SLTC Lab can quantify.
- Reporting limits (RL_{mass})are determined by the laboratory.
- Reporting Limits were calculated for air sampling results
- $RL_{air} = RL_{mass} / V_{air}$

Example: RL_{mass} = 0.01 mg, V_{air} = 0.2 m^3

RL_{air} = 0.01 mg / 0.2 m^3 = 0.05 mg/m^3

- Reporting limits (RL_{mass}) are set by the laboratory.
- Air volume (V_{air}) is determined by field personnel.
  - Sample Time **x** Sample Flow rate

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Shore Cleanup

- Tar ball removal
- Oiled sediments, vegetation, and debris removal
- Manual sorbent application and removal
- Pollution investigation
- Sump & pump/ vacuum trucks

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Shore Cleanup Results

- 2032 Sample Results
  - 2027 (99.8%) of the samples were below the reporting limit
  - Samples detected
    - Coal tar pitch volatiles (benzene soluble fraction) (4), Oil mist (mineral) (1)
  - None of the chemical exposures exceeded any occupational exposure limit

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Vessel Booming & Skimming

- On-water operations
- Various skimming techniques
- Oil patrols
- Environmental sampling
- Boom application, removal, tending

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Vessel Booming & Skimming

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Vessel Booming and Skimming Results

- 2490 Sample Results
  - 2469 (99.2%) of the samples were below the reporting limit
  - Samples detected
    - Benzene (1), Xylene (2), Ethyl benzene (1), Toluene (2), Trimethyl benzene (1), Coal tar pitch volatiles (benzene soluble fraction) (2), Oil mist (mineral) (3)
    - Propylene glycol (9)
  - None of the chemical exposures exceeded any occupational exposure limit

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In-Situ Burning

- On-water destruction of “fresh” oil
- Upwind end of contaminated area ignited and allowed to burn to down-wind end

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In-Situ Burning

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In Situ Burning Results

- 95 Sample Results
  - 95 (100%) of the samples were below the reporting limit
  - None of the chemical exposures exceeded any occupational exposure limit
  - Elevated CO (peak) concentrations measured on igniter boats equipped with gasoline powered engines

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Decontamination

- Vessel decon
- Boom decon
- Equipment decon
- Wildlife decon
- High and low-pressure washing

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Decon

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Decon

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Decontamination Results

- 3773 Sample Results
  - 3600 (95.4%) of the samples were below the reporting limit Samples detected
    - Xylene (6), Ethyl benzene (1), Toluene (4), Petroleum distillates (1) (Coal tar pitch volatiles (benzene soluble fraction) (61), Limonene (49), Oil mist (mineral) (48)
    - Sodium hydroxide (2)
    - Sodium chloride (1)
  - One of the chemical exposures exceeded an occupational exposure limit
    - 1177 ppm Toluene exposure to worker conducting boom repair

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Personal Protective Equipment

- PPE programs were reviewed and guidance provided
- Respirators not required, with the exception of:
  - Operations at the source (respirators used according to direct reading measurements)
  - In-situ burning (escape respirators available if necessary, rec. by NIOSH)
- PPE used mainly for skin protection
- Necessary to balance PPE requirements with heat stress issues

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Lessons Learned

- Improved coordination between laboratory and field personnel
  - Ensure sampling times (i.e. volumes) are adequate to ensure reporting limits are below appropriate OEL
- Use diffusive samplers whenever possible
  - Less manpower needed to collect samples
  - Less disruptive to workers
- Improve coordination between field personnel and data management personnel
  - Quicker feedback of sampling reports to field planners

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