CONCURRENT SESSION 4 – WATER RESEARCH AND OIL SPILL RESPONSE

Questions and Answers

- **Anonymous:** Question for Robyn: What is the magnitude of natural chronic oil seeps? Do you ever have to respond to those?
    - **Robyn Conmy, U.S. EPA:** At EPA, and for any agency that might have response for spill-related incidents, there would never be a need to respond to a natural oil seep; they happen frequently. In fact, there has been some estimates globally, at least in ocean environments, about 50% of the oil released into the ocean is from natural sources. It is part of the ecosystems that are there; the oil can be degraded and enters the food web and does not seem to pose any issues to the organisms used to utilizing that material. We would not have the need to ever respond to an event like that. What we happen to do a lot now is use them as natural test beds. We cannot spill oil on purpose for research purposes, so we try to find where there are different seeps for natural gas and oil and use those as natural test beds for looking at new technologies. The National Oceanic and Atmospheric Administration (NOAA), U.S. Coast Guard, EPA, and the U.S. Department of Interior (DOI) have all actively been doing that over the past 5-10 years.
- **Anonymous:** Question for Robyn: What are some of your unique large and small test facilities?
    - **Robyn Conmy, U.S. EPA:** As any research or operations project will tell you – it is hard to scale up from small to large without having lots of different effects; and how do you know what translates or is scalable from one size to the next? We tend to work at lab scale (small beakers) all the way up to natural seeps in the ocean. Some of our frequently used facilities – there is one, the Ohmsett facility in New Jersey – which used to be EPA-owned but is now run by DOI – that is 200m long (about two football fields long) and is very deep and has waves and currents, and we are able to treat it like a real ocean. We also do smaller more controlled experiments in flume tanks – we use the ones up in Canada at CRRC – so we can deploy sensors, we can spill oil, we can put dispersants in there, herding agents, surface-washing agents (if you want to see how the material moves with the oil). We have a wide range of ones that we use. Recently, our group just went out here in Cincinnati, Ohio – ORD has a streams facility in Ohio – and we are in early conversations with how we could conduct some oil experiments using the streams facility; that is something we have not been able to do at all.
- **U.S. EPA:** Question for Robyn: You talked about the REMUS during your talk and some of the other AUVs; I am curious if you have seen a lot of technological advances in those over the years or do you see any advances coming? Or is it a stagnant field?
    - **Robyn Conmy, U.S. EPA:** There has been a lot of advances in the vehicle technology (just how you move things around, making sure your data can be offloaded easily, battery life length). There are other vehicles that we are looking at now at Woods Hole that are called long-range AUVs that you deploy and they stay out for a whole month, so very low power demand; they hang out at the bottom or surface (depending on where they are deployed) and they are able to stay out and survey a large area. They do not have a lot of sensors on them (because of power demand), but there has been so many wonderful new technologies that have come out just in the vehicles. Then in addition to that is the sensors – they are getting smaller, faster, more sensitive, and so the optics are getting such that we can now better resolve the difference between oil and other things in the water at very

low concentrations – that is what the Santa Barbara seep study showed us – so there is a big push for examining these new kinds of technologies. On the policy side, and on the operations side, in the United States, we have what is called the 'SMART' protocols; if we were ever going to burn oil or consider dispersants, we have to put monitoring in place for surveillance. The last update was in 2006, so it is based on much older technologies and does not include anything for UAS or AUVs. So, now, the National Response Team (NRT) Science and Technology (S&T) Committee this year has taken up the issue of revisiting SMART and updating it with more of a matrix approach (having tables that have all these new technologies) – some you would never use for a small spill, but others that you can use for very quick routine spills that are better than the technologies that are written into the protocols now.

- **Anonymous:** Question for Mace: Do the underwater sensors work as well in large rivers as they do in the ocean? River water characteristics can change drastically, very quickly.
  - **Mace Barron, U.S. EPA:** The biggest difference between marine versus freshwater environments is issue of downstream movement of oil. Things like the real expensive response challenge for the Enbridge spill in Michigan was that dilbets are a blended oil; they have a light fraction and then a heavy asphaltene fraction. The lights weather off really fast, and the heavy component sinks so then we have oiled the sediment. Most of the marine spills are focused on keeping oil off the shoreline – either corralling it, burning it, or chemically dispersing it with these surfactant-like compounds – and just keeping it from the shoreline. In a freshwater spill, response issues are how it is a much smaller system, so even if the oil volumes are relatively small compared to the marine environment, the impacts on the system are substantial.
- **Anonymous:** Questio for Mace: Is there research on the fate and transport in rivers? Flow data can be difficult to obtain.
  - **Mace Barron, U.S. EPA:** Not that I am aware of. I had in my slides and Robyn mentioned that we have a world unique experimental stream facility that EPA manages that would be a really great thing. Right now, most of global hazard assessment has either one or two things happen: you either (1) use laboratory tests to benchmark the different oils or to understand a particular product *or* get a sample of particular sediment or water sample and determine if that is toxic or not or, (2) we are out in the field collecting and trying to examine population impacts and doing census on organisms. There is a big disconnect– either they have the lab or the ecosystem. We have been able to fortunately work in lake systems; they are kind of intermediate in terms of ecological realism because they'll have mesocosms and they are either enclosures in a lake or outside of a lake (such as large-scale experimental chambers exposed to the elements), or in this case a stream facility. So that would be a new area for oil-spill research and we are hoping to be able to do that.
- **Anonymous:** Question for Mace: Are model organisms for these methods chosen for any reason like their unique biological traits or habitat choice, etc.?
  - **Mace Barron, U.S. EPA:** Great question. Standard test organisms evolved during the 70's, and the initial impetus was wanting something small that could be tested in lab setting, could be cultured and maintained to be healthy in small beakers/test vessels – that was really the driver. The next evolution was: are they sensitive? How representative are they of a broader ecosystem if we are only testing 2-3 organisms? We want to make sure there is a fish and an invertebrate. Traditionally we have used crustaceans (crabs/shrimp), but some of the most diverse species in freshwater environments are mollusks and clams, also aquatic insects are huge. We are finally starting to address that. The final piece of the puzzle (we are not there yet) is examining all the trophic interactions. What happens if you have a chemical/spill that kills primarily plankton? What happens to the organisms that feed on the plankton? What kind of translational effects go up the food chain?

That is where the science is going. A lot of the organisms selected are because they are available, we can culture them, and we have developed protocols so that many laboratories could do these tests; you do not need to be Woods Hole Oceanographic to test your deep-ocean species – you can just use the commercially available. They are used globally. Our strategy in the toxicity testing world has been has just been to adapt these existing protocols and then benchmark them to see if they are of relatively representative sensitivity.

- **Anonymous:** Question for Helen: What is the future of LEDs in water disinfection? What technology advances and new capabilities do you see coming?
    - **Helen Buse, U.S. EPA Post Doc:** Great question. Probably just the expansion of these LED technologies. Their applications have been expanding over the past several years; they have low energy requirements and perform well, obviously, and just – their size. In these premise plumbing environments, we know the risk to opportunistic pathogens comes from inhalation of contaminated aerosols that are generated by our normal usage of plumbing fixtures. We have been seeing UV/LED point-of-use filters, another one of our EPA colleagues developed a UV shower head, and I have seen development of UV/LED tubing to use as water piping material. These applications have been growing because these LEDs are so easy to manipulate. As a follow-up to the study that I presented here, we are working with our collaborators and we really want to see if UV-treated water could impact downstream biofilm formation, since biofilms are an important reservoir for drinking-water microbes. In the coming years, I think we are going to see more and more of these targeted decontamination applications of this UV treatment in our premise plumbing systems where the bulk of our exposure to these pathogens occurs in these types of settings.
- **Anonymous:** Question for Helen: Besides LEDs, what are your thoughts about other biofilm mitigation technologies like enzymes, sonication, probiotics, and surfactants?
    - **Helen Buse, U.S. EPA Post Doc:** I am all for them – like I said most of drinking water microbes reside in these kinds of matrices, so targeting them would be a very good way to control their occurrence in the system. That is on the books, and we are looking at anti-biofilm ranges that are derived from coral material but right now we do not really know what the 'secret sauce' is. However, we are working with the manufacturer to test that in our labs. We are going at it from multiple angles and trying to manage pathogens in both water and in the biofilm matrix.
- **Anonymous:** Question for Nelson: What do you see as the future and sustainability of AMI? How does this intersect with the increased concern of cybersecurity attacks?
    - **Nelson Mix, U.S. Public Health Service:** I just did not give a good history of what has been going on, but there is really been a revolution in the last 10-15 years in metering compared to the last 100 years or more, and it has to do with technology and communications. During Monday's opening plenary with Nitin Natarajan, he talked about cyber and how there are chips in refrigerators; all of our smart meters now have chips. That is what enables GPS sensoring, if it is moved or been tampered with, and how you get those types of alerts. Obviously, encryption is a part of it, and much of this stems back to 15-20 years ago when bandwidth was opened up and the 'internet of things'. Related to cyber, it is obviously a concern, but there is some encryption that can take place, and with good cyber hygiene, I don't think it is as much of a concern. We acknowledge in the guidance document that we should follow federal guidance out there for these operating systems.
- **Anonymous:** Question for Nelson: What are the challenges to maintaining our drinking water infrastructure?
    - **Nelson Mix, U.S. Public Health Service:** Obviously aging infrastructure is a huge issue, and meters wear out and lose their accuracy over time. Utilities routinely replace meters, and they are replacing older mechanical meters with newer solid-state meters that have these built-in

communications. These platforms allow utilities to get a better handle on water quality and water quantity throughout the distribution system. So, it does not replace pipe as far as infrastructure issues, but it does give more data and helps with resilience. I think some of the big takeaways from the metering business is that when AMI and AMR (which pre-dates AMI, when cars would drive around and read the signal to send you a bill) – are collecting data once a month to send a bill, and this metering is a part of the infrastructure. With the technology, the reads are 4-6 times per day, which provides better resolution as to where leaks are. AMI started as a way to save money for utilities in meter-reading (fewer miles driven, fewer people walking around) and it allows utilities to spend capital funds on infrastructure improvement. Then there is a conservation element to AMI – you save water – you are reducing the footprint using less electricity to pump water when you do not need it because you can figure out where leaks are and repair them and optimize pipe replacement in your capital improvement projects. Our point about AMI is the resiliency effort, it is a triple use of AMI: for security, for detecting backflow and tampering issues; there was a good case study last year during the COVID-19 pandemic (referenced in our guidance document): Cleveland Water used their AMI data to examine buildings that had low usage because everyone was at home due to the COVID-19 pandemic. They were able to push out alerts to those facilities to recommend flushing to get rid of stagnant water to improve water quality at premise plumbing. That is a great example of AMI related to decontamination and how it is part of the infrastructure and leveraging AMI.

- **Anonymous:** Question for Nelson: If a sampling device, such as an adsorbent that collects a target over an extended time, is directly connected to a water main (i.e., no air gap), is backflow prevention required so that the collected sample cannot backflow into the main?
    - **Nelson Mix, U.S. Public Health Service:** Backflow prevention devices – it is a separate conversation. In the guidance, we talk about two kinds of backflow: (1) back-siphonage and (2) back-pressure. If you have a water main that has a fire flow or has a burst or is flushing, it is a huge demand and will cause water to suck backwards through the meter from the premise into the main and cause contamination – that is back-siphonage. Back-pressure is if someone is intentionally and nefariously wanting to pump contaminate from an embassy or into an embassy or from a water main into an embassy and back and forth, or from their laundry sink in a home to get the embassy that is next door. We do not get into a lot of the backflow prevention aspects with AMI, but the important thing to remember about the AMI platform is it is a communication network, based on a lot of cellular and proprietary radio-frequency technologies that enable sampling or other sensors at the point of metering at the premise. So, temperature and pressure – pressure is really one that the industry is adopting more with respect to coupling center technology with metering technology – and remotely controlled valves is another aspect. This gets into the one way versus two-way communications and gets pretty technical. That does not really answer the question about air gaps on a main – which is not really the purpose of AMI – I just want to point out that there is a lot of other advantages and things you can do with AMI once you have that communications platform in place at thousands of points across the utility.