Restoration Advisory Board (RAB) Meeting Summary
DuPont Chambers Works FUSRAP Site
Hampton Inn, Pennsville, New Jersey
April 30, 2009

To: Interested Parties
From: George Bock, Project Manager, U.S. Army Corps of Engineers, Philadelphia District
Re: Meeting Summary, April 30, 2009 RAB Meeting

RAB Members Present	**Affiliation**
George Bock, Government Co-Chair	U.S. Army Corps of Engineers
Al Boettler	DuPont
Glen Donelson, Community Co-Chair	Pennsville School District
James Warner, Community Co-Chair	Salem County Representative, Dept. of Health
RAB Members Absent	
Janet Agnew	Community
Frank Faranca	New Jersey Dept. of Environmental Protection
Francis Faunt	Community
Mack Lake	Carney Point Township
Charles Morris	Community
Sin-Kie Tjho	U.S. EPA, Region II
Paul Morris	Borough of Penns Grove
Gary Ricketts	DuPont Chambers Works
Mel Beals	Pennsville Township Representative
John Prigger	Community
Facilitator Present	
Ann Johnson	Cabrera Services
Guests Present	
Ed McKenzie	Carneys Point resident
Cheryl Reardon	Assoc of NJ Environmental Commissions
Scott Northey	DuPont Chambers Works
Samuel Osborn	Carneys Point resident
Roger Nogaki	Corporation of Advanced Technology (CAT)
Jane Nogaki	NJ Environmental Federation (NJEF)
Mac Griffin	BOC Gas, Pennsville resident
Nicki Fatherly	U.S. Army Corps of Engineers - Baltimore
Valrie Hames	Cabrera Services
Jay Johnson	Cabrera Services
Kim Nelson	Cabrera Services
Mahmud Rahman	Cabrera Services
Joe Weismann	Cabrera Services
Carl Young	Cabrera Services

Welcome (George Bock, Project Manager)
The meeting started at 7:10 p.m. George welcomed everyone and requested that participants introduce themselves to the group. He reviewed the agenda and then provided an overview of the Manhattan Engineer District (MED) activities, the FUSRAP program and the Chambers Works project for any new guests in the audience. Technical project team members will then discuss the highlights of the Sitewide Remedial Investigation (RI), baseline risk assessment (BRA), and an overview of the Feasibility Study (FS), the engineering phase of the project.

MED Program – Background: During World War II, MED was created by the Army to carry out much of the nation's early atomic energy work, referred to as the "Manhattan Project". In the 1940s, 1950s, and 1960s work was done at a number of sites across the country in support of this program. After the war the Atomic Energy Commission (AEC) was formed in 1946 to continue MED efforts and seek ways to use nuclear energy for peaceful purposes. AEC conducted radiological surveys and cleanup activities at sites that were used during the MED program. These sites were evaluated for residual radiological contamination and were cleaned up during the late 1940s and early 1950s based on the science and cleanup standards of the time. In March 1974, AEC established FUSRAP to address residual radiological contamination at some of these sites. The Department of Energy (DOE) was created in 1977 and took over responsibility of FUSRAP. In late 1997, Congress transferred the program to the Army Corps of Engineers (USACE) for implementation of all cleanup activities.

MED History at Chambers Works: Operations involving uranium processing began at Chambers Works in 1942. The federal government contracted with DuPont to convert uranium oxide to uranium tetrafluoride and small quantities of uranium metal. A number of processes were used to convert the uranium oxide (brown oxide, recovery, green salt, metal, and hexafluoride processes) but no enrichment or depletion of uranium took place at the DuPont Chambers Works site. In 1948 and 1949 the AEC surveyed the site and decontaminated building surfaces based on the standards of the time. All buildings and areas were released back to DuPont for the company's use.

FUSRAP Background and Site History: During the 1970s and 1980s, DOE went back and started preliminary investigations to further evaluate and clean up areas on the DuPont property under the FUSRAP program. However, a nationwide lawsuit at the time limited that work. When transferred to the USACE in 1997 all cleanup investigations were planned and conducted according to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines (Superfund law). George discussed the CERCLA cleanup process and noted the stakeholders working together with USACE during the cleanup at Chambers Works (USACE lead agency, NJDEP, EPA, DuPont, and community).

George showed the FUSRAP site map and described the areas being investigated by the USACE for residual radiological contamination from MED operations. These six areas of concern (AOCs) have been grouped into the following three operable units (OUs) to facilitate the USACE's phased investigations:

- OU 1: AOC 1 (Building 845 Area) and AOC 2 (F-Corral)
- OU 2: AOC 3 (Central Drainage Ditch) and AOC 5 (Building J-26 Area)
- OU 3: AOC 4 (Historical Lagoon A) and AOC 6 (East Area)

Project Accomplishments: George then reviewed significant accomplishments at the site over the years for the benefit of any new guests.

- USACE removed personal protection equipment (PPE) and drums of decontamination waste at Building 845 (1998)
- After DuPont demolished Building 845 the USACE cut up and segregated the structural steel. Because this steel was contaminated with embedded uranium it was transported to an offsite disposal facility (1999)
- USACE held first community and public meetings (2000)
- USACE completed the first major intrusive sampling effort at OU 1, Building 845 and the F Corral (2001 and 2002)
- USACE completed an intrusive sampling effort at OU 2, Building J-26 and the Central Drainage Ditch (CDD) and managed the proper disposal of all investigation-derived waste (2003)
- USACE completed cone penetrometer testing (CPT) and groundwater well installation at OU 1 and OU 2 (2004)
- Completed groundwater well installation throughout the site and field investigations at OU 3 (2005 and 2006)

- Continued groundwater monitoring and sampling events. Additional samples collected in support of baseline risk assessment (2007)
- Report (RI and BRA) preparation, internal review, and submittal to regulatory agencies (2008 and 2009)
- Report (FS) preparation and internal USACE review (2009)

Sitewide Remedial Investigation: Carl Young discussed the results of the Sitewide RI and baseline risk assessment (BRA) reports. These reports will be sent to the regulators within the next month for their review and comment (May/June 2009). Carl reviewed the FUSRAP Site map and summarized the five year investigation to identify the nature and extent of MED-related contamination. OU 1 consists of the areas used by MED to process uranium; OU 2 includes the drainageways leading from uranium production areas; and OU 3 consists of known or suspected disposal areas used during MED times.

Under FUSRAP, the USACE is authorized to cleanup radioactive contamination resulting from the Manhattan Project or hazardous substances (chemicals) used directly in the processing of radioactive material. By investigating past operations and materials used at Chambers Works, the USACE determined that the following radionuclides were eligible for cleanup under FUSRAP: the isotopes of natural uranium (U-234, U-235, and U-238), and two decay daughters, Ra-226 and Th-230. No chemical constituents were identified as eligible contaminants. Samples were collected and analyzed from all media (soil, sediment, surface water, groundwater, and air) over the 5 year investigation.

OU 1 Investigation Results: In OU 1 (AOC s 1 and 2), the uranium production areas, residual uranium in soil is primarily within the footprint of former production buildings. Uranium contamination is found in the shallow soils beneath the loading dock in AOC 1 (former building 845) and in AOC 2 to deeper depths, up to 20 feet below ground surface under the footprint of former building 708. In general, uranium was encountered in groundwater where elevated uranium was found in soil. Although extremely high concentrations of uranium were found in groundwater within the contaminated source zones (soil) the levels drop off dramatically in the downgradient wells, within a relatively short distance (less than 100 feet). Concentrations in these wells drop to less than the drinking water standard for uranium (30 micrograms per liter). Carl emphasized that the Chambers Works is an industrial site and land use is very likely to remain industrial well into the future. In addition, groundwater beneath the facility is not used for drinking water.

OU 2 Investigation Results: The next phase of the investigation was to evaluate OU 2, the drainageways or ditches leading from OU 1 production areas and the former Jackson Laboratory (Former Building J-16). USACE collected soil, sediment, surface water, and groundwater samples in the Central Drainage Ditch (AOC 3). Investigation results in AOC 3 showed limited and isolated areas of elevated uranium contamination above the ISV in soil and sediment samples. Most contamination is found near the surface (within 0-3 feet) except at the far end of the CDD. Here uranium occurrences were deeper (4-7 ft bgs) in near the former edge of the Basin Complex (Historical Lagoon A). No surface water or groundwater impact was identified in AOC 3. In the area of the former Jackson Laboratory (AOC 5) investigation results showed no MED-related contamination above the ISV in soil and groundwater. Five existing DuPont wells were also sampled in this area during the groundwater monitoring program.

***OU 3 Investigation Results*:** The next phase of the investigation included potential MED-related disposal or fill areas. AOC 4, Historical Lagoon A (Basin Complex) and AOC 6 (East Area) were evaluated in the OU 3 investigation. AOC 4 covers approximately 25 acres and has been extensively filled in and its configuration altered over time. USACE investigated around the perimeter and through the center of the lagoon to evaluate 1) deposition that occurred during the MED era and 2) reported debris and/or materials from MED buildings that may have been used to fill in parts of the former lagoon. Reports indicate that lab waste from the former Jackson Laboratory was disposed in the northern part of AOC 4 in the vicinity of DuPont's SWMU 5. Cone Penetrometer Testing (CPT) was used to evaluate more than 60 locations around the perimeter and through the center of the lagoon. Two areas were identified for further soil

sampling to define the extent of MED-related contamination (SWMU 5 area and eastern side of lagoon). In SWMU 5 Area (Area of Interest 1 [AOI 1]) uranium in soil above the ISV is limited to the upper 8 ft bgs (maximum concentration observed was 355 pCi/g at 8 ft). Groundwater contamination is limited to the area where uranium in soil is encountered (aerial extent 0.4 acre in AOC 4). This area is within the DuPont SWMU boundaries and contained by slurry wall installed by DuPont.

In AOC 6, the East Area, it was reported that MED waste and debris may have been buried at the fence line. From aerial photographs seven possible areas were identified as locations of fill and/or disposal activities. These areas were evaluated with a CPT investigation (more than 60 locations). Based on these results only two areas were identified for additional sampling. A soil boring program was then conducted in 1) East Road Area and 2) Fire Training Area. Shallow MED uranium contamination above the ISV was found directly below East Road, and totaled approximately 0.1 acre. Aqueous uranium was found in the B aquifer in the same area (no A aquifer present in AOC 6).

Carl discussed the geochemical conditions at the site that limits the movement of uranium in groundwater. U+6 only becomes mobile in oxidizing groundwater. Since reducing conditions are prevalent at Chambers Works the aqueous uranium found in groundwater has not migrated significantly in the last 65 years. The last several years of monitoring has shown no advancement of the impacted groundwater. It was emphasized that once the soil contamination is managed or removed, it is expected that the groundwater contamination will greatly reduced or eliminated.

All field sampling completed in 2007 and included all media (soil, sediment, surface water, groundwater, and air). A monitoring well installation and groundwater monitoring program resulted in a total of 39 USACE wells and 6 existing DuPont wells over a period ranging form 4-6 quarters.

In summary, results of the phased investigation at the three FUSRAP OUs:

- **Soil:** Uranium impacted area (above the ISV) is about 2.5 acres in OU 1 and less than 0.1 acre in AOC 6. Depth limited to approximately 8 feet bgs.
- **Groundwater:** Uranium impact to groundwater is limited to areas with soil contamination and occurs within the OU boundaries. Monitoring data shows little or no migration. The contaminated groundwater is typically within the upper 20 feet or less.
- **Sediment:** Limited impact in drainage ditches near source zones.
- **Surface water:** No impact.

Baseline Risk Assessment: The purpose of the baseline risk assessment is to estimate ecological and human health risks from exposure to site contaminants and identify areas with unacceptable risks. Risk depends on exposure and toxicity and the evaluation includes the following four steps:

1. Data Collection – uses data collected from RI
2. Exposure Assessment – identify completed exposure pathways (how much, how often and how long)
3. Toxicity Assessment – how much & what kind of harm
4. Risk Characterization – evaluates amount of possible exposure and toxicity to calculate risk

USACE conducted ecological evaluations for all six AOCs. Only two areas had suitable habitat for ecological receptors so these areas were further evaluated by performing a screening level ecological risk assessment (AOCs 3 and 4). Results showed that eligible contaminants and chemicals encountered within these AOCs do not pose any risks to ecological receptors.

The site is zoned for industrial land use and it is expected to remain that way into the future. USACE wants to ensure that the FUSRAP areas are cleaned up and safe for industrial workers in the future. Current and future receptor scenarios were considered in the BRA. Potential human receptors likely to be onsite were evaluated and included: industrial worker; construction worker; utility worker; and the maintenance worker. Typical exposure durations were estimated for each worker. Additionally, the BRA evaluated a residential receptor and used those results only for comparison purposes.

A conceptual site model shows the different routes of exposure for possible receptors at the site. To have a risk there must be a completed pathway (contamination, receptor, and receptor contact with contaminants). Different workers would be exposed differently to site contaminants and USACE modeled these differences.

Carcinogenic risks from both chemical and radiological contaminants were evaluated separately and were not summed. Dose and risk assessment results for radiological contaminants exceeded acceptable criteria in two areas. In OU 1 unacceptable risks were identified for the construction and utility workers. In AOC 6 unacceptable risks were identified for the industrial and construction workers. Therefore, site specific cleanup standards will be developed and OU 1 and AOC 6 will be further evaluated in the feasibility study (FS).

Community Questions on Sitewide Remedial Investigation and Baseline Risk Assessment

1. *How far are the municipal wells from the areas of impacted groundwater on the Chambers Works property?* Carl showed the regional map with the municipal well capture zones located in relation to the property boundary and areas impacted with MED uranium in groundwater. It is approximately one mile to the municipal wells.
2. *How does groundwater pumping, done by DuPont affect the FUSRAP wells and areas?* The DuPont Inceptor Well System pumps groundwater from deeper water-bearing horizons than the shallow aquifers impacted by MED activities. This system influences the B and C aquifers and controls groundwater flow in towards the center of the manufacturing area.
3. *How long was groundwater sampling conducted?* USACE sampled over 40 wells; most for 6 consecutive quarters; however some were only installed and sampled for four consecutive quarters. Over the sampling period USACE did not see significant movement of impacted groundwater. This is because the uranium in groundwater is only mobile in the presence of oxygen. The geochemistry of the groundwater under Chambers Works (reducing conditions) limits the uranium from becoming soluble and moving away from the source zones.
4. *Did USACE sample any wells off the property?* No. USACE sampled in known areas of MED activity and where uranium was encountered in soil. Additional samples were collected, moving out from these locations, to define the horizontal and vertical extent of contamination. There was no evidence from monitoring to sample beyond the property boundary.
5. *Did USACE sample for radium and thorium in groundwater?* Yes.
6. *What were the finished MED products, produced at Chambers Works?* DuPont accomplished a great deal for the federal government within a short period of time (MED operations). They produced uranium hexafluoride that went to Oak Ridge for enrichment and uranium metal.

Feasibility Study (FS): Jay Johnson, environmental engineer with Cabrera Services, discussed the overall process, evaluation criteria and some of the actions that are being considered in the FS. The FS identifies and evaluates various remedial alternatives to address unacceptable risks posed by soil and groundwater contamination. The FS does not recommend a cleanup action for a site but instead goes through a number of screening steps and a detailed evaluation to compare likely remedial alternatives. Jay showed and described the steps in preparing the FS and the criteria used to evaluate different alternatives (CERCLA requirements).

The FS will focus on the areas where human health and/or environmental risks exceed the acceptable criteria. Then an initial list of technologies will be developed and evaluated. The FS team starts out with a broad list, evaluates each technology, and pares down the list to the most likely options. Then those options are evaluated and the most promising remedial alternatives are identified. The FS then evaluates the remedial alternatives according to criteria set forth in CERCLA. Threshold and balancing criteria are evaluated at this stage in the FS. To meet the Threshold Criteria, a remedial alternative must be

protective of human health and the environment and comply with ARARs. Balancing criteria are then evaluated for each alternative and include implementability, use of treatment technologies, and cost.

Jay then described applicable or relevant and appropriate requirements (ARARs) and that all cleanup decisions need to comply with other state and federal environmental laws and regulations (CERCLA Section 121(d)). In the FS, ARARs are identified to meet specific remedial action goals. For Chambers Works FUSRAP site, the soil remedial action objectives include:

- comply with ARARS;
- eliminate or minimize potential human exposure; and
- minimize movement of contaminants offsite.

For groundwater the remedial action objectives include:

- comply with ARARs;
- monitor, control, or actively reduce concentrations of contaminants; and
- prevent aqueous uranium from migrating beyond site boundaries.

Jay then described typical remedial actions that have been used at similar FUSRAP sites. Potential remedial actions for contaminated soil include land use controls (deed restrictions); excavation and disposal offsite; containment (capping); and volume reduction. For contaminated groundwater, potential options include land use controls, groundwater treatment; and monitored natural attenuation.

Jay pointed out a combination of actions is usually the most appropriate. For instance institutional controls will be part of several options both for soil and groundwater. Two areas, AOCs 1 and 2, are being evaluated as one package because the areas are adjacent to one another and have similar site conditions. The other area, AOC 6, will be evaluated separately. Both soil and groundwater alternatives are being evaluated for all areas. Jay indicated that the first draft of the FS is due to the USACE next month and more details will be provided at future meetings.

Community Questions/Comments on Feasibility Study

1. *What is the half life of these radionuclides?* The half life of Uranium-238 and Uranium-234 is 4.5×10^9 and 2.3×10^5 years, respectively. For radium-226 and thorium-230 the half lives are 1590 years and 8.3×10^4 years respectively.
2. *Unlike the uranium, why have other metals become mobile and moved off site?* Some metals can move in reducing environments. Mobility depends on the chemistry of the groundwater and the behavior of the specific metal or constituent.
3. *Is there residual contamination from uranium hexafluoride process?* No uranium hexafluoride is a gas and no residual amount currently exists.
4. *What are your objectives to remove the hot spots of soil?* One likely option is to excavate soil and ship it to a permitted facility for disposal in a secure waste cell. There is one facility in Idaho; typically these facilities are out west where there is very little rainfall. The soil is put in containers and shipped usually by rail. This happens on a daily basis and is an extremely safe method of transportation.
5. *What are the typical life expectancies of these disposal facilities?* These sites are designed to safe for a long time. The facilities are closely regulated, have management plans, and reporting requirements. For ones that have stopped operating, they have closure plans which include continued monitoring of site conditions.
6. *In the FS do you take into account climate change and sea level rise?* In the FS long term effectiveness of a proposed remedial alternative is considered.
7. *Is the local community encouraging the USACE to consider returning the FUSRAP areas to pristine conditions?* George responded that through community outreach and discussions with stakeholders the community's fully expects the site to remain as an industrial site well into the future and that appropriate controls will be in place.

George then reviewed the project schedule indicating that the RI and BRA reports will be delivered to NJDEP, EPA, and DuPont within the next month (May/early June 2009). He also provided a source for residents to get information on occupational exposures and illnesses as compiled by DOE. He also reviewed the updated project website and made sure that new guests were aware of the correct web address: **http://fusrap.eaest.com**

The group scheduled the next meeting for October 15, 2009 at the Hampton Inn.

Meeting Adjourned at 9.00 pm