Questions from the 700-C fan public meeting held on December 10, 2020

Joni Arends: What happened to the machinery that was supposed to replace the diesel machinery in the underground?
WIPP has a plan to replace the bulk of its diesel-powered fleet with battery electric equipment or diesel-powered equipment with lower emissions. NWP has already replaced 5 of its diesel-powered salt hauling vehicles with engines with the Tier IV Final platform. This is an engine which cools the exhaust for more efficient filtering of diesel particulate matter and treats the remaining gaseous exhaust with a process known as selective catalytic reduction (SCR). SCR is a chemical process which renders the nitrogen dioxide emissions into harmless exhaust. The trucking industry uses similar technology. WIPP is continuing to implement its plans to replace the bulk of its diesel operating fleet with battery electric equipment and already has a number of battery powered vehicles in the WIPP underground. However, due to the size of the mine at WIPP, battery electric equipment is not readily available and must be custom designed and fabricated. As such, it is not possible to immediately replace the entire fleet of underground vehicles at WIPP with battery electric vehicles. WIPP will continue to pursue the replacement of the diesel equipment with battery electric equipment into the future, regardless of the final status of the 700-C fan.

John Wilks: Why was the 700C fan not operational?
The 700-C fan was automatically shut down by the ventilation system controls when it detected the radioactive material release accident in February of 2014. The DOE decided to keep the fans shut down following the accident while it conducted investigation and recovery of the mine from the event.

Joni Arends: The CRESP paper did not state what materials they reviewed. Please provide that information.
All documents reviewed by CRESP are posted on the WIPP.energy.gov website, under the 700-C Fan Test Information link. The specific documents posted are:

- The Estimate of Release paper
- The Rationale Paper for starting the 700-C fan
- The Fact Sheet
- The 700-C Fan sampling and monitoring plan

Steve Zappe: Can the 700-C fan initially be started in filtration mode? Does it have to be shut down to switch from filtration to normal, or can you switch from filtration to non-filtered while it is running? I'm asking to see if you can reduce the potential of release from an initial startup of the fan.
The 700-C fan has always been an unfiltered fan. It has no filters associated with its structure hence it cannot be started in filtration mode. Starting the fan with the filtered ventilation fans (the 860 series) is not allowable by interlocks in the ventilation control system.

In order to switch the underground ventilation system to the filtered mode, the 700-C fan is first shutdown from the WIPP Central Monitoring Room. This is a push of a button on a screen

in the control room and can be accomplished in seconds. Next, operators would be dispatched to the 700-C fan to manually shut dampers in the ductwork isolating the 700-C fan and then open dampers in the ductwork routing the ventilation to the HEPA filters which would filter the exhaust when an 860 filtered ventilation fan was started. Turning off the 700-C fan effectively stops all airflow in mine, removing any motive force which could carry radioactive materials from the underground to the fan discharge.

Jean Stevens: How can we be sure that all the above "facts" are reliable? There have been too many reports that have later proven to be not accurate. I am especially concerned about the USA misinformation via the disposal of major nuke waste in the Marshall Islands (a dome on an atoll about to be overtaken by the Pacific Ocean as a result of climate change and thus destroying much biodiversity in the South Pacific). Billions of dollars already wasted due to contamination and lack of transparency already at WIPP.

I cannot address the concerns related to the Marshall Islands, but I can tell you that we employed a very rigorous and deliberate process to ensure that we are adequately protecting the public while improving air quality in the underground, which our workforce deserves. Nuclear Waste Partnership (NWP) sampled the salt build-up in the ductwork, analyzed the data as well as the data from several air monitoring stations and calculated what is believed to be a bounding release potential. This calculation package was independently reviewed by NWP's subject matter experts (SMEs) and then reviewed by DOE. DOE has several radiation and nuclear safety SMEs, both at the DOE Carlsbad Field Office and at HQ. Both sets of SMEs reviewed the calculation package and determined that it was conservative and expected to be bounding. Additionally, due to the expected public interest in the matter, DOE had CRESP, an organization of academics from across the nation to review and provide input into NWPs evaluation. This process has taken almost two years to complete. The final product has been made available to the public and is posted on the WIPP website under the 700-C button. Further, as a means to validate NWPS analysis and ensure that we remain protective of the worker, public and environment, DOE is utilizing a phased approach to the restart of the 700-C Fan. The first step is the 4-hour test run where we will collect radiological data and analyze it to ensure we remain protective. DOE will make the results of the sampling effort available to the public. If the data supports moving forward, DOE will conduct a 5-day balancing run to balance air flows in the underground. DOE will collect additional samples, analyze them and make them available to the public. If that data continues to show that operation of the 700-C Fan remains safe, DOE will progress on towards routine operation of the 700-C Fan during non-emplacement operations.

Paige Murphy-Young: At what distance from WIPP is "any member of the public" assumed to be located?

335 meters; this is for an individual at the work site for the Safety Significant Confinement Ventilation System (SSCVS), which office space is located 335 meters East Southeast of the 700 fans.

Scott Kovac: What monitoring will occur during the 5-day run? What monitoring will occur during routine operations?
WIPP monitors the exhaust coming from the WIPP Underground with air samplers upstream of its HEPA filters at the top of the exhaust shaft. These samplers are in a sample station known as Station A. These are continuous monitors which sample the airflow anytime any ventilation fans are operating. WIPP has air monitors on site to meet compliance with NESHAPs requirements. Both of these monitoring systems will be in service during the 5-day run and later during routine operation.

WIPP has formulated a sampling plan for the 4-hour test with a comprehensive suite of both airborne radiation monitoring equipment and surface deposition collection equipment. The data from these instruments will be evaluated and used to determine the appropriate level of monitoring which would be conducted in the 5-day run and following into normal operations.

George Anastas: WIPP is a contaminated Nuclear Category 2 Facility. Which contaminated Nuclear Category 2 facilities have operated ventilation without filtration during the past 10 or so years, notwithstanding Fernald more than 30 years ago.
The type and level of ventilation systems used in DOE Nuclear Category 2 and Category 3 nuclear facilities is determined on the hazards in the facility and the controls necessary to ensure protectiveness to the worker, the public and the environment. DOE has evaluated the use of the 700-C fan for 4-hour test, the 5-day balancing run, and for subsequent routine operations during non-waste emplacement activities and has determined that operation of the WIPP ventilation system in unfiltered mode is acceptable, improves overall safety at the site by increasing airflow and quality to the underground. Ventilation systems for other DOE facilities designed and operated in accordance of the specific hazards and required controls as stipulated in the safety basis documents for those facilities.

Joni Arends: Please explain how the proposed 5-day test and balance will comply with Section O-31 of the NMED HWP for WIPP.
The Test and Balance makes up one of the three processes of the mine ventilation rate monitoring plan and is described in Permit Attachment O, Section O-3a. If DOE decides to operate the 700-C fan, then the 5-day test and balance will become the baseline for underground ventilation system operation during mining operations. If the 5-day test and balance becomes part of the baseline for underground ventilation system operation, it will be summarized in next year's Mine Ventilation Rate Monitoring Annual Report as required by Permit Attachment O, Section O-5a.

David Mccoy: Specific contaminants? Pu-239? Am-241 Why no filtration of exhaust air?
NWP will monitor for isotopes of concern including Pu-239/240 and Am- 241. From a 40 CFR 61 Subpart H air emission perspective, which is the regulation for the protecting of the public and the environment, the restart of the 700-C fan will result in emissions well below any regulatory thresholds. The very conservative calculations and estimated dose due to resuspension of deposited material is conservatively estimated to be well below any regulatory limit and would add an additional 1/2000 of a millirem.

Protection of site workers and 10 CFR 835 requirements for occupational exposure were also considered. This regulation limits worker dose based on the Derived Air Concentration (DAC) method, the expected highest level of exposure to workers directly involved with the testing are estimated to be 0.014 DAC and these workers will be wearing personal protective equipment during the test.

Steve Zappe: Will the CAMs be mounted at the same elevation as the stack outlet or will they be on the ground?
CAMs will be placed at ground level.

Joni Arends: Will the NMED DOE Oversight Bureau also be conducting independent sampling and monitoring?
No, results of the sampling will be provided to the NMED. Independent sampling will be conducted by the Carlsbad Environmental Monitoring Research Center (CEMERC).
The below information is being provided as follow up to the response given during the meeting.
DOE is aware that NMED has expressed an interest to either split sample or perform independent sampling. DOE has no objections to NMED performing their own independent sampling or split-sampling with DOE. NMED personnel would be required to comply with site and operational specific training and requirements (e.g., PPE use) as would WIPP personnel.

Kalene Walker: How far away from exhaust fan are the closest monitors? distance, please
Two shrouded probes mounted to the face of the 700-C discharge are connected to ground level samplers through an engineered system of tubing and split connections. Each of the two shrouded probe points feeds up to 3 samplers for a total of 6 sample collection points. In addition, an existing sample collection point (Station A) exists in the exhaust shaft at the elbow where the air discharged from the underground reaches the surface. Station A monitors will see what is pulled from the underground and the 700-C discharge monitors will see what passes Station A as well any residual radionuclides in the surface ductwork downstream of Station A up the 700-C discharge point.

Adrian Hedden: If WIPP has operated with all filtered air since the 2014 incident, why is it now safe to use unfiltered air?
WIPP has collected sampling data from its Station A monitoring system since the radioactive release accident in February of 2014. This is the exhaust air from the filtered side of the mine. That data has indicated readings in the normal background range since June of 2014, even following the addition of a new filtered ventilation system (the Interim Ventilation system) to the WIPP underground. In addition, in the 6 years following the event, there have been a multitude of intrusive operations conducted in the WIPP underground which disturb the salt. The risk of these operations causing resuspension of radioactive materials entrained in the salt into the exhaust air was the main reason for the decision to filter the exhaust air from the underground these past 6 years. These operations have proven not to cause any increase in the detectable levels of radioactive materials at Station A. This data was the basis for the paper presented at the 2017 Waste Management Conference by Dr. Thakur of the CEMERC where the independent scientists determined it was no longer necessary to filter WIPP's exhaust air. The

DOE has pursued a number of strategies to increase the airflow in the mine, with the culmination of these being the installation of the Safety Significant Confinement Ventilation System. That is still a few years in the future. Since the radioactive material release risk has proven to be so small, and the benefit of the additional airflow to the miners now to be so tangible, DOE decided to pursue the option of restarting the 700-C fan.

Joni Arends: Will EPA be conducting independent sampling and monitoring of the proposed tests?
DOE is not aware that the US EPA has expressed an interest to either split sample or perform independent sampling. DOE has no objections to the US EPA performing their own independent sampling or split-sampling with DOE. US EPA personnel would be required to comply with site and operational specific training and requirements (e.g., PPE use) as would WIPP personnel.

Chris Fischahs: Why not just wait until the new supplemental ventilation system (with HEPA filtration) comes online? Purposely expelling unfiltered air from the contaminated WIPP underground seems unnecessary, as it is being operated today. Why not just wait?
Newer more restrictive air quality controls were put in place by changes to 10 CFR 851, Worker Safety and Health in February of 2019. These newer controls have made it more difficult to conduct operations in the WIPP underground and have reduced the margin to the new occupation exposure limits, particularly to Nitrogen Dioxide, a major component of the gaseous emissions from the diesel equipment, in service in the WIPP underground. The SSCVS is not scheduled to be available for at least two years. Because the estimated release during operations of the 700-C fan is so far below the existing regulatory requirements the reduction in the air quality margin of safety of operating the fan compared to the benefit in the air quality margin of safety to the workers in the mine was determined to be worthy of exploring.

Adrian Hedden: Why now? How is the decision to move forward with restarting the fan related to delays, if any, in the SSCVS and utility shaft projects?
DOE has been evaluating the possibility of operating the 700-C fan in unfiltered mode for ground control and mining operations for several years. In 2017, CEMERC first recommended that DOE should consider the operation of the 700 series fans again in an unfiltered mode, Nuclear Waste Partnership (NWP) and DOE went through a deliberate process to collect and evaluate data to reach this conclusion that it is safe and beneficial to the workers to resume operation of the 700-C fan. Although there have been delays to the Safety Significant Containment Ventilation System (SSCVS) project and the Utility Shaft project, DOE efforts to resume operation of the 700-C fan were independent of those projects. Given that operation of the 700-C improves underground air quality with minimal risk for a potential release, DOE was planning to move forward with this activity even if the two projects had been on schedule.

David Mccoy: What operational data did CRESP examine before making their conclusions
All documents containing operational data reviewed by CRESP are posted on the WIPP.energy.gov website under the 700-C Fan Test Information link.

Deborah Reade: What has changed to make you feel that it isn't necessary to filter the exhaust anymore? The risk to the public seems to have remained the same?
Newer more restrictive air quality controls were put in place by changes to 10 CFR 851, Worker Safety and Health in February of 2019. These newer controls have made it more difficult to conduct operations in the WIPP underground and have made it more difficult to protect our workforce and meet the new occupation exposure limits, particularly to Nitrogen Dioxide, a major component of the gaseous emissions from the diesel equipment, in service in the WIPP underground. The SSCVS is not scheduled to be available for at least two years. Because the estimated release during operations of the 700-C fan is so far below the existing regulatory requirements the reduction in margin of safety of operating the fan compared to the benefit in margin of safety to the workers in the mine was determined to be worthy of exploring.

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Paige Murphy-Young: While your answer to Steve Zappe describes why an in-operation switch from non-filtered to filtered mode takes a few minutes, could you clarify why filtering doesn't occur from the beginning?
The current airflow from the underground is operated in filtered mode, but only allows for limited air flows to the underground (~146,000 cubic feet of air/minute). Increasing the airflow in the underground improves worker safety be removing exhaust fumes and other non-radiological contaminants found in the air. Although the 700 series fans (700-A, 700-B and 700-C) were originally used to exhaust air from the underground, they only operated in an unfiltered mode. In order to shift to filtered mode, the 700 series fans would be shut-off and a different set of low-flow (860 series) fans would exhaust the air from the underground through a set of HEPA filters. These low-flow fans were supplemented with some additional fans to increase the amount of filtered airflow. However, to filter the exhaust air coming from the 700-C fan, a new filter housing or filter building would have to be designed, constructed and installed on the outlet of the fan. The calculated estimated release rates have determined the worst-case release of any radioactive materials would be thousands of times below the allowable regulatory release limits. Additionally, DOE is already in the process of constructing a new facility (i.e., Safety Significant Containment Ventilation System (SSCVS)) that will allow greater airflows to the underground while operating in a filtered mode. This project is not scheduled to be completed for a few years. As such, operation of the 700-C increases worker

safety and health in the underground in the interim period while construction of the SSCVS project is completed.

Deborah Reade: Why didn't you answer George Anastas' question? Can you name any contaminated Nuclear Category 2 facilities that have operated ventilation without filtration in the last 10 years?
The type and level of ventilation systems used in DOE Nuclear Category 2 and Category 3 nuclear facilities is determined on the hazards in the facility and the controls necessary to ensure protectiveness to the worker, the public and the environment. DOE has evaluated the use of the 700-C fan for 4-hour test, the 5-day balancing run, and for subsequent routine operations during non-waste emplacement activities and has determined that operation of the WIPP ventilation system in unfiltered mode is acceptable, improves overall safety at the site by increasing airflow and quality to the underground. Ventilation systems for other DOE facilities are designed and operated in accordance of the specific hazards and required controls as stipulated in the safety basis documents for those facilities.

Steve Zappe: If this test proves there is no significant release from operating the 700-C fan, why would you need the new utility shaft?
The 700 series fans are as old as the facility itself and they have a usable lifetime and so, right now they will be used to increase airflow until the startup of the SSCVS which will carry WIPP into the future for all of the operations that we anticipate until the closure of the facility.

George Anastas: CEMERC monitoring data and NMED monitoring data are one or more years behind. There should be prompt (not years) reporting of the data. remember that monitoring is post release of Pu-239, AM-241 and the other isotopes tapped in salt and released without filtration
This is a statement, and no response was given.

Kalene Walker: I'm sure WIPP has top notch radiation monitoring equipment, could you tell us what type you will be using, and what will be measured at source point. neutrons? CPM? alpha beta etc.^^rad monitoring equipment
The CAMS you are referencing are the continuous air monitors and two types will be used during the test. The Canberra ICAM HD will be used to monitor the Panel 7 exhaust the Bladewerx Sabrealert will be monitoring outside the 700-C fan. The ICAM will monitor for alpha and beta activity and the Bladewerx will monitor for alpha activity in air. The low volume portable air samplers are basically a pump and filter media collection system. Those air filters will be collected along with the CAM filters and transported to the WIPP Labs at the completion of the test along with the ground deposition samples. We have pans so we will be able to collect samples from a pristine environment to be able to determine exactly what type of radioactivity, if any, we receive during the test. Those will also be counted in the field with a 2360 instrument from Ludlum attached to a 4393 probe, which is an alpha beta integrated count system. The technicians will be able to get immediate readings in using this instrument. In addition technicians will perform removable smear surveys of these pans which will be monitored on a Tennelec Series 5 XLB (extra low background). Those samples will also

be saved and they will be transported to WIPP labs where they will undergo laboratory analysis for more precise measurements and verification of our count activity.

Deborah Read: Ground control is essential, but isn't the real reason for the unfiltered venting so you can emplace waste more quickly? You could do just ground control with the air you have now.
Newer more restrictive air quality controls were put in place by changes to 10 CFR 851, Worker Safety and Health in February of 2019. These newer controls have made it more difficult to conduct operations in the WIPP underground and have reduced the margin to the new occupation exposure limits, particularly to Nitrogen Dioxide, a major component of the gaseous emissions from the diesel equipment, in service in the WIPP underground. Although we could continue operations in the same manner that we are currently performing them, DOE desires to improve the air quality safety margin in the underground while mining and ground control occur. It should be noted that the bulk of these emissions occur in the underground during ground control and mining activities. Waste emplacement operations, due to the nature of the equipment needed, do not generate the amount of diesel exhaust generated during ground control and mining. The 700-C fan will only be operated to support mining, ground control and maintenance activities in the mine. Waste Handling will be prohibited during operation of the 700-C fan.

Gary Doolen: What is the expected lifetime of the 700C? What fraction of the time per year is the 700C expected to be shut down? Are the 700A and 700B available for 700C backup?
We anticipate that the 700-C fan will run whenever we are doing non waste handling operations until the SSCVS comes online. Our estimates are that that is going to be a few years likely two years or so.

Currently the only two 700 series fans that would be available 700 Charlie and 700 Bravo. 700 Alpha was actually taken out of the system whenever we added the interim ventilation system in 2016. That fan has been blank flanged off from the system and cannot be restored back to operations. The 700 Bravo fan was available and is still inside the ventilation duct works system and we could have run that, the Nuclear Waste Partnership did an evaluation as to the ability to revive the 700-B fan and it has more issues than 700 Charlie had. We had removed the electrical power that would have powered the fan so it faced a little bit longer return to service than the 700 Charlie fan would so we made the decision that the 700-C fan would be the one we would pursue to restart.

Currently the 700 Charlie fan is going to be running alone. We have not set up either 700 Bravo because of the issues I talked about or 700 Alpha because it's just not available.

George Anastas: Were the draft provisional documents that were evaluated identical to the documents DOE/WIPP recently provided to the public?
They were in draft form, but were very close to the completed documents. We did make some changes at the recommendation of the CRESP team and we made a few minor changes to the documents, but they were essentially in their final form.

David Mccoy: Will CRESP follow up looking at the operational data if 700C fan begins operation?
We intend to provide information from the 4-hour test to all stakeholders including CRESP. We will invite CRESP to take a look at the data so that get their response. In the future, the data from the 4-hour test and the 5-day run will be available to all of our stakeholders.

Don Hancock: The DNFSB has been asking questions for more than a year. Have you answered all of their most recent questions and provided all the documents that they have requested?
We recently provided that information to the DNSFB. They provided us with a series of questions or lines of inquiry and our folks had a discussion with them and then provided them the necessary documentation. There are and we expect there will be continuing ongoing conversations regarding the startup activities to ensure that we are good to proceed.

George Anastas: What steps will DOE/WIPP take to prompt CERMERC and NMED and anyone else to promptly provide the independent sampling data??? Or will DOE/ WIPP allow any independent monitoring lag for a long time.
The department would encourage the dissemination of information in a timely fashion. However both of those entities are independent agencies. The information that the DOE collects will be provided to the public approximately two weeks prior to the 5-day balancing run if the decision is made to move forward with the run. Regardless we will provide the information whether or not the decision is made to proceed with the 5-day run.

George Anastas: For the CAMs that were identified. what are the minimum detectable limits. (Taulbee answered)
8 DAC-hr.

Kalene Walker: Will you be counting neutrons?
No

David Mccoy: Is there potential for any accidents that could lead to the necessity to not shut down the 700C?
During the 4-hour run, there will be no other activities in the underground in order to minimize the potential for any accidents that could inhibit us from completing the test or causing any harm to the workforce.

Scott Kovac: When will the public be made aware of the results of the 4-hr test?
WIPP data and independent CEMRC data from the 4-hour test will be posted approximately one to two weeks following the test to allow time for laboratory analytics and subsequent technical evaluation prior to posting. Data will be posted at least 2 weeks prior to the underground test and balance evolution.

George Anastas: How long does it take for the 700-C fan to coast down once the signal is given to cease operating the fan??
It takes several minutes for the fan to coast down but there are dampers that close faster, both automatically and there is an additional manual damper. It takes approximately two minutes for the fan to spin down and 30-45 seconds for the automatic dampers to close.

Joni Arends: CCNS wants the 4-hour data to be available in realtime. Will DOE/NWP/WIPP commit to providing the monitoring/sampling results in real time?
This is not possible as the bulk of the data collected has to be sent to a lab to be counted or analyzed. We estimate at least a week for the laboratory analysis and data verification and validation to complete. The data will be posted a minimum of two weeks prior to the underground test and balance evolution.

Scott Kovac: The results of the 4-hr test will equal to a certain amount. Will the 5-day run equal to 30 times that amount? What about accumulation?
The dose estimate to the maximally exposed member of the public offsite and those to the neighbors, the fence line and the public are extrapolated out to be an annual number if the 4-hour test were continued for an entire year. When Mr. Blunt did the calculations using the CAP 88 formulas, the isotopes and the curie available from the source term, the numbers you are seeing in the report are annual increase to the annual exposure at those points. The numbers for the health physics technicians and the workers are based on hour to hour rates. There are two different sets of data based on two different sets of functions. We anticipate that the 4-hour test will give us a confirmation that we are no worse than what we calculated and we estimate that the numbers will be one to two orders of magnitude less than the calculations. We have been highly conservative in our estimates and calculations to ensure that we didn't underestimate any values. There are three components to the values. There is the Station A component that is the air that currently comes out of the air daily. That air will be a continuous value into the future. There is some contamination in the surface area that will be emitted during the initial startup of the fan and then go away as the fan runs and thirdly there is some residual salt that will be under a resuspension calculation and will continue to contribute over time. So two of the three components will continue over time the surface salt and Station A. Those two numbers will make up the estimated calculated dose rate and the exposure to members of the public.

George Anastas: Does DOE/WIPP review CERMERC monitoring data before the data are released?
NWP does not review CEMERC data prior to the information being released.

Don Hancock: I submitted a number of questions on Monday. I haven't heard answers to most of them tonight. Are they going to be answered?
Yes, we received your questions and we will develop answers for them and post them. We do look forward to providing the answers to the questions as well as the results of the 700 fan tests on the WIPP website under the 700-C fans. Thank you.
<u>This information is being provided as a follow up to the meeting:</u>

Answers have been posted.

Steve Zappe: This meeting is being recorded… where will the recording be posted?
Due to a technical issue with Zoom, the recording is not available. We apologize for the inconvenience.

David Mccoy: What are the actual expectations for release given normal operation including the most likely accidents that could occur or for the maximum event?
This question was answered previously in response to Scott Kovac's question. We have been very conservative in our calculations and anticipate that the results of the test will show values 1-2 orders of magnitude lower than our calculations.

George Anastas: Are the Station A probes collecting salt such that the probes clog up and data are lost.
Multiple probes are located at both station A and station B. The probes and sample lines are periodically removed and replaced with cleaned probes to ensure at least one clean probe is in place and collecting samples at each location.

Air exits the WIPP underground through an exhaust shaft, and there is a large elbow located at the top of the shaft. Probes are located at the elbow and the air is continuously sampled at that location, upstream of filtration. This sampling system is called Station A. After the exhaust is filtered using the Underground Ventilation Filtration System and Interim Ventilation System, the air exits through a discharge point called station B where additional probes are located, with continuous sampling and continuous radiation monitoring. We analyze the samples at both locations, upstream and downstream of filtration, and samples from both locations consistently have results far below discharge limits.

Joni Arends: Are there photos and/or video of condition of the ductwork? If so, please post them to the WIPP 700-C fan webpage.
Photos are below.

Main duct looking South towards the elbow

Main duct looking South towards the elbow