Dr. Robert Anigstein of Sanford Cohen & Associates (SC&A) Interviewing Former Employees of General Steel Industries (GSI)

Meeting Date: October 9, 2007, 4:00 p.m., Holiday Inn, Collinsville, Illinois

Attendees:
Robert Anigstein, PhD, Sanford Cohen & Associates
Former workers from General Steel Industries, Inc., and other interested parties

NIOSH Team/Support Staff (as observers)**:**
Stuart Hinnefeld, National Institute for Occupational Safety and Health (NIOSH), Health Physicist

David Allen, NIOSH, Health Physicist

Mark Lewis, Advanced Technologies and Laboratories (ATL) International, Inc., NIOSH Worker Outreach

Mary Elliott, ATL, NIOSH Worker Outreach

Note: This meeting was arranged by Dr. Robert Anigstein of Sanford Cohen & Associates (SC&A) and a spokesperson for former workers from General Steel Industries, Inc. (GSI) to gather information for use in SC&A's review of Appendix BB – General Steel Industries for the Advisory Board on Radiation and Worker Health (ABRWH). Appendix BB is a document that was prepared by the National Institute for Occupational Safety and Health (NIOSH) for guidance in the radiation dose reconstructions of former GSI workers who have filed claims, or whose survivors have filed claims on their behalf, under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA).

NIOSH neither arranged for nor conducted this interview. However, the agency paid for the hotel conference room used for the interview at the request of SC&A. Representatives of NIOSH were invited to attend this interview due to the subject matter. The interview immediately preceded a 7:00 p.m. NIOSH Town Hall Meeting on Appendix BB.

A NIOSH contractor prepared these minutes, which have been redacted in accordance with the Privacy Act of 1974, 5 USC § 552a for posting on this Web site.

Dr. Robert Anigstein opened the meeting by stating that he is employed by Sanford Cohen & Associates (SC&A). He described his background as a nuclear physicist with 25 years of experience in the field of radiological assessment. SC&A is the scientific consulting firm that is contracted to the Advisory Board on Radiation and Worker Health (ABRWH or the Board). The Board oversees the NIOSH dose reconstruction efforts under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA) to assure that it is scientifically correct. Dr. Anigstein is reviewing Appendix BB – General Steel Industries for the Board. He explained that the purpose of the interview was to get information on the layouts of Betatron facilities, the positions of the objects being radiographed, and the proximity of the workers when the exposures were made.

Dr. Anigstein asked [name redacted] if he had a drawing of the facility. [name redacted] replied that he had layouts of the plant showing the old and new Betatron facilities, as well as Buildings 8, 9, and 10, which were connected to the new facility, and a small testing facility located in Building 6.

[name redacted] stated that the former workers represented a cross-section of the employees who worked routinely in the Betatron radiography facilities – operators, supervisors, maintenance workers, and inspectors. [name redacted] noted that the timekeeper [name redacted] was present, as well as the metallurgist [name redacted] who managed the GSI Betatron project at the beginning of the Atomic Energy Commission (AEC) contract. [name redacted] also introduced the AEC-licensed radiographer [name redacted] who came to GSI as a contractor to perform source testing outside the Betatron facilities.

[name redacted] stated that GSI also sent castings to Allis-Chalmers in West Allis, Wisconsin, and Baldwin-Lima-Hamilton in Lima, Ohio, because those facilities also had Betatron radiography equipment.

[name redacted] stated that the group had additional information from a facility in Milwaukee, Wisconsin, that archives Allis-Chalmers' records and manuals, including a Betatron operations manual.

[name redacted] spread the drawings of the Betatron facilities on the table for use during the discussion. [name redacted] stated that the railroad tracks ran from the 10 Building into the new Betatron facility through an unshielded ribbon door. He indicated the location of the control room as well as the magneto and equipment rooms that were situated above it. [name redacted] estimated that the concrete walls around the perimeter of the building extended approximately 12 feet high, with the remainder of the walls above the shielding constructed of corrugated steel. The new Betatron facility also had a corrugated metal roof that had a pair of fans for ventilation. The room was heated by a gas furnace with ductwork located along the wall.

Dr. Anigstein asked about the location of the castings during a shot. [name redacted] answered that most of the shots were made "inside the turn of the L" toward the center of the building. He stated that the Betatron crane moved along fixed rails that gave the machine physical limits. Under normal operating conditions, it was not pointed toward the control room or toward the railroad tracks during a shot. When Dr. Anigstein asked how far the Betatron could travel, [name redacted] replied that the Betatron crane could travel westward inside the building until it reached the hoisting crane, at which point it had to stop because both cranes were on the same rail.

Dr. Anigstein asked if the limits kept the Betatron from pointing toward the ribbon door. [name redacted] stated that he had been instructed by [name redacted], who managed the Betatron operations after [name redacted], to invert the machine by sending signal to point it downward 90° and then eastward 90° in order to make a shot in the "dead area." When he questioned [name redacted] regarding the reason for the unusual change, he was told to mind his own business. Since the Betatron operations were "highly classified," he did as he was told because he did not want to put his job on the line. He stated that the Betatron could violate its own limits and be pointed at either the control room or the ribbon door when inverted in this manner.

Dr. Anigstein asked if the control room was cleared when the Betatron was pointed in that direction during a shot. [name redacted] replied that the machine had to be fired from the control room. He said that the machine was inverted as an economic measure to avoid moving the casting, which was a time-consuming process. [name redacted] stated that [name redacted] had never given him an order to circumvent the limits of the Betatron when he managed the facility.

A brief discussion ensued regarding the specifications of the control room. Dr. Anigstein stated that the Betatron facilities were constructed according to Allis-Chalmers drawings, which specified that the walls should be ten feet thick. Drawings made during cleanup of the GSI site that the Oak Ridge National Laboratories (ORNL) conducted from 1987 to 1998 also indicated that dimension. [name redacted] stated that he did not think that was accurate. An unidentified former worker stated that he thought the walls of the control room were the thickness of one eight-inch concrete block.

[name redacted] asked the other Betatron operators if they had ever been ordered to invert the unit. Three of them replied that they had done so. [name redacted] indicated that he had never made an inverted shot. When Dr. Anigstein asked how often they were asked to invert the unit, [name redacted] replied that it was not done often, but stated that "once is too often." He estimated that the last 10 shots of the 300-400 shots required for a large turbine shell might be made with the Betatron inverted to save a casting move. Another former worker added that a casting move might take several hours.

[name redacted] stated that 10-15% of the shots might be considered "long shots" (having long exposure times). The time varied with the thickness or type of the casting. A steam chest casting with horseshoe ribs would necessitate longer shots due to the added thickness. Castings between three and five-and-a-half inches thick were shot with AA film at a distance of nine feet because at a closer distance the film would be overexposed. Castings between six and eighteen inches thick were shot at six feet with AA film.

Dr. Anigstein asked if the Betatron was kept in one position toward the center of the room even when it was pointed the "wrong way." [name redacted] replied that smaller castings were placed on a revolving steel table. Occasionally, larger castings would be set up on railroad cars and the Betatron unit would have to be moved to accommodate the shot. Dr. Anigstein said that he had spoken several days earlier with the Allis-Chalmers technical maintenance supervisor [name redacted], who had gone to GSI on several occasions. [name redacted] told Dr. Anigstein that the units had been installed so that the limit switches made it impossible to get close enough to the railroad tracks to do a shot, but that GSI may have used it differently later.

Another worker stated that the Cobalt-60 source scattered everywhere because it did not have limits.

[name redacted] stated that [name redacted] was trained at Allis-Chalmers before he came to manage the Betatron operations at GSI. He later went to LANL.

[name redacted] stated that the easiest way to move the limit switch was to bump the Betatron crane a couple times.

[name redacted] produced a photograph from the Allis-Chalmers manual that showed a large casting being shot on a railroad car. Dr. Anigstein said that he had seen a copy of the photograph.

Dr. Anigstein asked if the "old Betatron" operated in the same manner. [name redacted] stated that the controls were "a little different" on the "old" 24 MeV (megaelectron volts) unit, but that the units were basically the same. The Old Betatron Building had a much larger control room with a stand-up console, while the control room in the New Betatron Building was smaller and had a sit-down console. He also pointed out the location of the "old" Betatron unit against a wall in the Old Betatron Building.

Dr. Anigstein mentioned that at a previous worker outreach meeting, a former worker had mentioned using a survey meter. [name redacted] replied that they used Macbeth survey meters to measure the radiation exposure rate in the work area. The workers considered themselves to be "safe" if the meter indicated not more than two milliroentgens per hour (2 mR/hr). Dr. Anigstein said that 2mR/hr is a standard in radiation safety. He asked if the readings were ever taken when the Betatron unit was turned off after a shot. [name redacted] replied that there was some residual radiation, but it did not cause a very active response from the survey meter. The meters were kept on the desk in the control room and were calibrated during every shift. [name redacted] stated that he was employed as an administrator at St. Louis Testing at that time of the contract. His company calibrated the survey meters for the Betatron facilities. The survey meters measured X rays and gamma rays, but not neutron radiation. In response to several others workers' comments about not using the survey meter, [name redacted] stated that [name redacted] did not require them to use the survey meters during the operation of the Betatrons, but some workers did to double check the exposure rate. However, they were required to use them when they used the Cobalt-60 source and other radioisotopes. When [name redacted] asked [name redacted] when he worked at GSI, he indicated that he worked there from 1962 to 1973. [name redacted] asked [name redacted] if the survey meters were the same when he managed the Betatron operations in the earlier years of the contract, he replied that they were always there.

[name redacted] turned the discussion back to the layout of the Betatron facility. He stated that the side wall of the control room where the door was located (around the corner of the "L") was not more than 19 or 20 inches thick. He estimated that the metal door jamb was approximately six inches deep, including the door stop that was approximately one inch thick on the control room side of a standard one-and-three-quarter inch thick steel door. He estimated that there was "another two inches of concrete block before you made the corner." [name redacted] agreed. [name redacted] said that the drawings were correct in regards to the 10-foot depth of the perimeter walls. [name redacted] produced photographs showing the entrance to the control room in the Old Betatron Building.

Dr. Anigstein asked if an attempt was made to clear other workers from the area outside the Betatron facility when the unit was inverted. (No audible response.) [name redacted] said that they put sandbags down over the railroad tracks at the base of the ribbon door to the 10 Building when they inverted the Betatron for a shot because the tracks left gaps when the door was down.

He described the unshielded ribbon door as standard (approximately 15-16’ x 18-20’). When Dr. Anigstein asked if the beam of the Betatron could extend outside the ribbon door, [name redacted] replied that objects could be shot in the “dead zone” when the unit was inverted but the unit could not traverse far enough along its rail for a direct beam to reach the door.

An unidentified former worker related an unusual event that happened when he was operating the Betatron. After making several shots, he noticed that a pallet of film was against a wall in the shooting room (around the corner of the “L” in the “dead zone”). He stopped shooting to remove the pallet to the darkroom and noticed that the edges of the film had been exposed by the Betatron. The film was used anyway. Dr. Anigstein asked if the Betatron had been inverted. The former worker replied, “No.” Dr. Anigstein explained that the exposure had been caused by scatter radiation.

[name redacted] asked Dr. Anigstein if the beam of the Betatron could “ricochet” off the walls. Dr. Anigstein replied that photon radiation either keeps going or stops when it hits matter. When photon radiation is stopped, it interacts with the material to generate new photons of lower energy going in different directions (scatter), but original photons cannot change directions. [name redacted] said that they had used a lead scatter shield (approx. 3/8” x 14” x 17”) behind the film to prevent it from being exposed by backscatter off the walls. Dr. Anigstein explained the photon energy that would result from a 25 MeV Betatron shot.

A discussion ensued regarding the effects of these exposures on the workers’ film badges. Dr. Anigstein explained that film badges would show beta and gamma radiation but not the neutron radiation, which would have been generated inside the Betatron unit while it was operating. A different type of film is used to record neutron exposure. [name redacted] said that they used pencil dosimeters occasionally. He trusted the pencil dosimeters more than the film badges because the dosimeters could be read instantly, whereas the film badges had to be sent out for processing after a given time period.

Dr. Anigstein asked about the structure marked “Break Area” on the drawing of the New Betatron Building. Some of the workers could not recall this area, while others responded that it may have been an area where the breakroom and restrooms were located. Mr. Allen pointed out that the area may have changed because the drawings were from a different time period, either 1989 or 1993. [name redacted] said that on the older drawings, the area was a tunnel that connected the New Betatron Building to 10 Building. [name redacted] asked [name redacted] to describe the railcar system. [name redacted] said that the electric transfer car ran on a wide track through the 8, 9, 10 Building and into the New Betatron Building. The car had a thick metal flatbed attached to an undercarriage where the electric motor was mounted. The electric cable for the system was in the 8, 9, 10 Building on a retractable coil. The track was wider gauge than a standard railroad track. One former worker said that the car was big enough to hold half of a Westinghouse turbine, which required two 60,000 pound ladles and a back-up ladle of 20,000 pounds to pour. (The casting weighed approximately 129,000 pounds.)

[name redacted] said that the 8, 9, 10 Building was one open building with pillars to hold up separate roof peaks for each area. There was a wall between the 12 Building and the Number Two Foundry but it was open-ended where the patterns went in and out of the building.

[name redacted] said that there was no shielding in the ceiling in the upper area of the Betatron Building. Dr. Anigstein pointed out that the upper area was not occupied. [name redacted] stated that the gamma rays from the high levels of radiation would cause “skyshine.” Dr.

Anigstein said that he was aware of the effects of skyshine. [name redacted] said that he had problems from skyshine when he was taking measurements using iridium and cobalt sources in the gamma ray and X-ray rooms that he had built at St. Louis Testing. Dr. Anigstein said that NIOSH had taken skyshine into consideration in the dose reconstruction models.

A discussion ensued between Dr. Anigstein and [name redacted] regarding the location of workers outside the shielded area of the Betatron facility when the unit was in operation. [name redacted] said that crane operators, electricians, and maintenance workers all worked as needed above the shielded area outside the Betatron buildings. Dr. Anigstein asked if that occurred during the Betatron shots. [name redacted] replied that he went up on the roof of the New Betatron Building to perform routine maintenance on the exhaust fans and at no time communicated with the Betatron operators regarding whether they were shooting during the scheduled maintenance. At other times, the maintenance workers and electricians would use an outside crane to perform repairs or maintenance on fans, cranes, and gearboxes that were located above the 10 Building and the Heat Treat facility, which were in close proximity to the area above the shield walls of the Betatron facility.

[name redacted] said that the New Betatron Building was located in a very active, highly populated part of the plant. The drawings indicate that the Betatron facility was about 30 feet from the break room where workers punched the time clock (in the 10 Building). When [name redacted] asked how many people worked in the 10 Building during peak production, [name redacted] replied that approximately 300 people worked during each of 3 shifts, including welders, chippers, grinders, burners, and Magnaflux operators. [name redacted] said that the environment was hot, smoky, and very dirty from all the activity. [name redacted] was the timekeeper for 140 employees and there two other timekeepers for day shift employees in the building. He estimated that there could have been as many as 400 workers on first shift in the 10 Building, with fewer workers on second and third shifts.

[name redacted] said that after the Betatron shots, the castings could go anywhere in the 8, 9, 10 Building. The 8 Building was the machine shop, and 9 and 10 were the repair floors. [name redacted] asked how much time elapsed between a shot being completed and the casting being removed to another area for repairs. [name redacted] replied that the castings were taken out of the Betatron area as soon as the films were checked. [name redacted] stated that it took him 13 minutes to process the film and about two minutes to read it, so 15 minutes was the minimum time elapsed. A film reader was on duty during every shift, because it was important to get a good "readable" shot before the casting was sent out of the Betatron area. Dr. Anigstein asked how much more time elapsed between the time the films were read and the repairs began. [name redacted] said that it could be as little as 15 minutes or as long as two days, depending on how important the job was.

Dr. Anigstein asked about the uranium pieces that came to GSI from Mallinckrodt for Betatron testing. One former worker recalled that the uranium came in circular slabs that were approximately four inches thick and 18 inches in diameter. Some of the pieces were half-circles. He said that it took longer to shoot the uranium than it did to shoot a steel casting. Dr. Anigstein explained that the density of the uranium is much higher than that of steel. [name redacted] said that the thickness of the uranium slice was a function of its density.

Dr. Anigstein asked about the high manganese steel alloys that were produced at GSI. [name redacted] explained that manganese keeps steel castings from being brittle. He said that every casting made at GSI contained a minimum of 60 to 90 points manganese (0.6 to 0.9 %) in a casting that may have weighed hundreds of tons. He said if the steel was a manganese grade there may have been as high as 15% for Hadfield's Austenitic Manganese Steel. One former worker recalled that GSI used the high manganese steel to make castings that were used for rock crushers. Some of the mantles for the high manganese castings weighted up to 20,000 pounds.

Dr. Anigstein revisited the topic of maintenance in the New Betatron Building. He asked [name redacted] how much time he spent servicing the exhaust fans in the roof. [name redacted] responded that he spent 20 minutes every six months servicing each fan. He also spent time in the New Betatron Building servicing the cranes and all of the hydraulics in the Betatron unit as well as the bearings and gear boxes on the car that was used to set up the castings for a shot. [name redacted] said that the maintenance crew spent entire days servicing the Betatron facility when the unit was down, even eating their lunches "on top of that stuff." [name redacted] worked at GSI from 1955 to 1973. He stopped in the Old Betatron Building often because it was a convenient place to get warmed up in the winter after servicing outside equipment. He said that pipefitters and machinists often performed maintenance in the Betatron buildings, but that it was difficult to schedule the maintenance because the units were in continuous operation. [name redacted] said that the Betatron units were off during the maintenance work, which was done during an 8 hour period on a Saturday.

[name redacted] stated that during the peak production periods from 1963 to 1966, the Betatron operated 24 hours a day, 7 days a week.

An unidentified former worker said that the uranium ingots from Mallinckrodt were kept in a storage area at the rear of the 7 Building, which was some distance from the 8 Building. He also recalled the ingots being "lined up on the furnace floor." Dr. Anigstein asked if all of the ingots were four inches thick. [name redacted] replied that he recalled receiving three railroad cars at once, all containing pieces that looked like pontoons, approximately six feet long.

[name redacted] cited a 1957 newspaper article from the Post-Dispatch with a photograph of the slices from uranium billets that were made at the Weldon Spring Plant.

[name redacted] stated that NIOSH had used a wage rate of $3.80 per hour in <u>Appendix BB</u>. He said that his Social Security records showed that he made $5,301.80 in 1966 working 11 months. He calculated that working 40 hours per week for 48 weeks (1920 work hours), his average wage would have been approximately $2.76 per hour, including overtime. Another former worker said that his pay rate was always under $3 per hour. Dr. Anigstein asked the former workers how many hours they worked during a typical workweek. [name redacted] said that they had compiled a labor manual that included an hourly rate. Another former worker stated that he worked for eight hours as a finisher on day shift and another eight hours a day as a second shift foreman. [name redacted] recalled that the pay rate for the contract may have been $2.85 per hour. He said that the workers aimed for a net paycheck of at least $500, because if they netted more than that the company had to issue a second check. He estimated that at a net rate of $2.45 per hour, 40 hours of overtime per week bring a net paycheck larger than $500. [name redacted] recalled that he made an hourly rate of $1.97 in 1953, and the company issued him a second check for three cents ($0.03) for one two-week period. Several workers produced pay stubs to illustrate this point.

[name redacted] was a production welder for 23 years and on the seniority list. He worked in the 10 Building on the castings from the Betatron every day. He commented that he had called

NIOSH to try to get them to change his work classification but was told that it would not make a difference (in his dose reconstruction). Dr. Anigstein stated that he could not give an opinion on the issue because he was working on a review of Appendix BB for the Advisory Board, not doing dose reconstructions.

[name redacted] commented that, based on the comments from the workers about their wages and hours, the 57-hour work week in Appendix BB was inaccurate by 20 to 25%. Dr. Anigstein asked them to describe again their typical work week. Several workers commented that the company had to observe the Illinois labor laws which required at least one day off every 14-day pay period. [name redacted] said that some people worked seven or eight double shifts in a 14-day pay period. [name redacted] said that an 80-hour work week was not out of the ordinary. The former workers agreed that 24 hours of overtime per week was about average. Dr. Anigstein noted that 65 hours per week might be considered a fair average.

Dr. Anigstein asked if someone could tell him about the high-activity cobalt source. [name redacted] said that St. Louis Testing brought a 10 curie (Ci) cobalt source to GSI to shoot six inches on a Westinghouse casting (?). The exposure time for the shot was one week and a half-day because they used an extra-fine grade film for Westinghouse. St. Louis Testing brought the cobalt source in ten times over a period of six months to shoot a turbine shell. The shell was shot in open air with a distance of six feet from source to casting because they wanted to shoot the entire casting with one exposure. Dr. Anigstein asked what kind of safety measures were used for the shot. [name redacted] explained that they put the casting on railroad car and ran it out to a spur for the shot. The area was secured with barricades and roped off with radiation warning signs. The survey meter in the exclusion area read 2 mR/hr, and two radiographers working 12-hour shifts kept the secured area under constant surveillance. Some repair shots were made in the repair area, but not in the Betatron facility. The shots were originally made with an Iridium-192 source (50 Ci), but the iridium showed more defects that the Betatron did, which meant more rejected castings.

Dr. Anigstein asked [name redacted] about the cobalt source that was owned by GSI. He responded that the GSI cobalt source was 80 Ci, and the castings were brought into the New Betatron Building on the railcar. The shots were done in the building, but not in the shooting area, so the Betatron was inverted. [name redacted] described how they shot the "weld prep" on a nuclear power plant channelhead. To set up the shot for the 10-foot diameter channelhead, the cobalt source came up through a tube that was propped up in the center of the casting. "Flex film" for 40 simultaneous shots was tied around the channelhead on a flexible belt so that the film was at a distance of six to seven feet from the source. Dr. Anigstein asked if the source was shielded during the shot. [name redacted] said the shielded source was attached to a cable that ran through a tube from the shooting room into the control room, where the cable was attached to a mechanism to crank the source completely out of the lead shield. [name redacted] said that the thickest area of the casting was in the "bowl area" or flange. [name redacted] said that the flex film had lead screens to keep it from being overexposed. [name redacted] stated that a dose of 4,000 mR, or 4R, was necessary when shooting extra-fine grain film with a cobalt source. [name redacted] said that such a shot would take six hours and 40 minutes.

When Dr. Anigstein asked if precautions were taken to keep people out of the break area when the Betatron was inverted, the consensus response was that there were no precautions taken at any time to keep people out of the breakroom, the darkroom, or the first floor office. The door to the control room was always locked. The second floor mechanical room was never entered unless there was a problem with the Betatron. [name redacted] said that he only remembered one instance when he had to go into the second floor room to shut down the magnetos after an explosion. Dr. Anigstein inquired about another door in the shooting room and was told that only the Betatron operators used that door to go in to set up the shots and to go reposition the films. There was a red flashing light that indicated when the Betatron unit was on, as well as a limit switch that shut down the Betatron unit if the door was opened during a shot. Dr. Anigstein confirmed that the breakroom was unrestricted.

[name redacted] stated that the safety precautions did not necessarily affect the cobalt source. [name redacted] explained how the cobalt scattered up through the equipment room into the control room, as well as into the 10 Building through the corrugated metal. Dr. Anigstein confirmed that the scatter effects were similar to skyshine, but the scatter off the walls may be worse. He asked if the 80 Ci cobalt source was used any place else at GSI. The former workers confirmed that the 80 Ci source was not used outside the Betatron Buildings. They said that there was a smaller cobalt source (0.25 Ci) that was used in the test area of the 6 building to examine railcar undercarriages. The 6 Building was constructed of eight-inch cinder blocks with an open roof and walls. The building was unsecured. Someone told about a worker who took home the cobalt source thinking it was a plumb bob and returned it a few days later.

[name redacted] commented about an incorrect statement about operating time in Appendix BB. He said that NIOSH as misquoted the Betatron operators in saying that it took three to four hours for a 10,000 R shot using the 25 MeV (new) Betatron. He stated the time should be corrected to one hour and fifteen minutes. The old 24 MeV Betatron would have taken longer because it did not have a capacitor bank.

Dr. Anigstein asked whether the Iridium-192 source that was owned by St. Louis Testing was the only one used at GSI or if there was a GSI-owned iridium source also on site. [name redacted] responded that GSI did not have its own iridium source. He said that the key point with this issue was the output of the isotope. The iridium source showed more defects on the larger castings than did the Betatron, so more costs were involved with its use.

Dr. Anigstein asked about a 250 KeV X-ray unit. [name redacted] verified that the smaller unit was purchased by request, but the unit was not used very much. The unit was kept in the New Betatron Building. Dr. Anigstein noted that there would not be much scatter using that machine.

[name redacted] said that the 0.25 Ci cobalt source had a disconnect switch attached to the cable in the shooting room. He related an accident in which the third shift operator finished a shot with the source near quitting time and inadvertently left it on. [name redacted] retrieved the source on the first shift. The first shift foreman called him because the survey meter was pegged and he wanted to verify that the meter had been calibrated recently. Another meter was brought in and it also pegged. Dr. Anigstein asked about the radiation field on the meter. [name redacted] replied that the maximum reading may have been 5 R, assuming that he was using the high scale on the meter. Dr. Anigstein asked if anyone was working in the building at the time. [name redacted] replied that first shift man had come into the building, but he was not certain how close he was to the source. He was uncertain whether the incident had been reported.

Dr. Anigstein recalled having read an account of a 2006 outreach event in which someone had stated that workers had been in the exposure room inside a casting during Betatron shots. [name redacted] stated that this had happened by accident on a couple of occasions. [name redacted] was inside a tank on the flatcar when it was sent over for a shot. [name redacted] was in the exposure room when the shot was taken. [name redacted] asked if there had been a warning horn on the machine, to which [name redacted] replied that "everything went off," but apparently [name redacted] had not been paying attention. Dr. Anigstein stated that he probably would not have gotten as much exposure from one shot as the film. On a separate occasion a draftsman from Plant Engineering came into the shooting room to measure something and the Betatron operator was not aware that he was in the building. He walked out of the room after the shot was taken. The incident was reported to security, but [name redacted] was not aware of what was done about the situation. It was handled by Personnel. [name redacted] stated that these events illustrated how many different types of workers were in and out of the Betatron buildings. Dr. Anigstein said that he had a "pretty good picture" of the Betatron facilities and asked if anyone had anything to add.

[name redacted] said that one maintenance worker did not come to work if he knew that he was scheduled to work in the Betatron facility because he was afraid to work in the building.

Another former worker stated that a television report about the Westinghouse plant in Missouri (Kansas City Plant) had told about a large amount of buried metal that had contaminated the ground water. The plant had been forced to remove the buried waste. The former worker asked how that might affect the GSI workers because the metal had come from the GSI foundry.

[name redacted] stated that he had asked the same question of Dr. Ziemer of the Advisory Board the previous Thursday. He worked in the New Betatron during the three years of peak operation. He was concerned that over the years, the Betatron machines emitted thousands of roentgens 24 hours a day, seven days a week. He asked how NIOSH could do accurate dose reconstructions "if there was no knowledge about the gross amount of roentgens that came out of those two machines." Dr. Anigstein responded that the two guidelines for a dose reconstruction were that it be scientifically accurate and claimant favorable. He explained that by using claimant-favorable "reasonable upper bounds," NIOSH can make an estimate of the workers' exposure that is likely much higher than the radiation doses that the workers actually received. NIOSH uses film badge data from the workers' records when it is available.

[name redacted] said that he was referring to the activation of the castings and the skyshine effects from irradiating the metals. Dr. Anigstein described the Monte Carlo Nuclear Particle (MCNP) program being used by SC&A to model the radiation effects of the Betatron unit on the uranium, steel, and other alloys. The model was constructed using the exact design of the Betatron. The purpose of the program is to arrive at the "reasonable upper bounds" for the gamma radiation and the activation products caused by the irradiation of the uranium and the steel and steel alloy castings.

[name redacted] commented that DOE and LANL agree that dust, air, and liquids were contaminated in the shooting room. In 1993, Uranium-238 was found in the railroad tracks of the Old Betatron Building, as well as the ventilation fans and the vacuum cleaner. Dr. Anigstein responded that the information was included in the modeling. [name redacted] expressed regret that the former workers were never told that their jobs could have been dangerous to their health.

[name redacted] added that the information in his dose reconstruction indicated to him that there was nothing accurate about dose reconstructions. He felt that the words "assumptions" and "probabilities" mean "nothing when it comes down to an actual dose reconstruction that is feasibly correct." [name redacted] said that it seems inaccurate and flawed to say that one person who has cancer is not compensated when another who works close by is compensated. Dr. Anigstein responded that SC&A is not working on dose reconstructions.

Several former workers commented on the clean up of the dump and the residual contamination at the property.

[name redacted] related an accident involving the 80 Ci Cobalt-60 source. He had been working the previous shift and was working overtime. The shot took 6 hours 40 minutes and when it was complete, he went to get the survey meter and it went to two mR. The cable hung up when he tried to retract it. The cable cranked in, but the “pill” did not, so he took the survey meter into the shooting room and it pegged as soon as he opened the door. [name redacted] had to crank the cable in and out three times before the source “pill” was reeled back in. The department head [name redacted] sent him to First Aid and they transported him to the hospital. The doctors there took blood samples and treated him with antibiotics, but were otherwise unsure how to treat him. They released him to go back to work after a few days off. He noticed that after his exposure, he seemed to be more susceptible to respiratory problems such as walking pneumonia. When he returned to work after the accident, he was working second shift on the maintenance crew. They looked into why the apparatus had not worked properly. They spoke with a machinist in the 8 Building who ran a cladding machine and realized that the large sources should also have cladding. [name redacted] said that the sources lacked cladding due to “corporate shortcuts.” (Approximately nine or ten years later, one of the same doctors did a biopsy and found cancer. [name redacted] was rushed to [identifying information redacted].

[name redacted] asked Dr. Anigstein if he was interested in information about “repair-issued castings.” A lengthy discussion ensued regarding the repairs that sometimes required several weeks to grind out and weld all of the defects in a casting before it met the specifications. The defects resulted from gas pockets that formed during the solidification of the steel and could be anywhere from pin-sized to very large. Sometimes as much as 500 pounds of flux might be needed to make the repair. The type of welding material was chosen to match the physical properties of the steel, not necessarily the chemical properties, and usually contained at least five percent manganese. Workers used a Magnaflux unit to test the castings for defects. Metallurgists used ultrasonic devices to locate defects in the casting to assist in setting up the Betatron shots. Sometimes the casting had to be taken to the Betatron facility multiple times, requiring a large number of exposures to indicate the progress of the repairs. If the films indicated the need for additional repairs, the castings were sent back to the repair floor for the defects to be ground out and welded again. [name redacted] stated that the repair history depended on the type of casting: The three most common castings sent to the Betatron facilities on a regular basis were HY-80 castings, turbines, and cast armor.

[name redacted] produced a set of magnetic letters and numbers and gave a demonstration on how Betatron shot was set up. He described how the markers were set up to differentiate the inside from the outside to show the defects in the casting on the film. An ultrasonic device was used to place the markers. A dye penetrant was also inserted with the flux material to show the defects on the films. [name redacted] stated that when the plant closed, some of the equipment was discarded and some was sold to other industries.

Dr. Anigstein thanked the former workers for the information that they had provided and concluded the interview at approximately 6:30 p.m.