THE DEPARTMENT OF ENERGY ORAL HISTORY PRESENTATION PROGRAM

OAK RIDGE, TENNESSEE

AN INTERVIEW WITH

GRADY WHITMAN

FOR THE

OAK RIDGE NATIONAL LABORATORY

ORAL HISTORY PROJECT

INTERVIEWED BY

STEPHEN H. STOW

AND

MARILYN Z. MCLAUGHLIN
(ASSISTANT)

FEBRUARY 24, 2005

TRANSCRIPT BY
BRIAN VARNER

STOW: Today, we're talking with Grady Whitman. Grady came to Oak Ridge in 1944 as part of the SED [Special Engineer Detachment] group, and he has some stories to tell us about those early days. He started his work at the Oak Ridge Y-12 Plant with the Stable Isotopes Program and has been with ORNL ever since then, retiring several years ago. Grady, tell us a little bit about how you got started in engineering to back in Ohio.

WHITMAN: Well, like many kids back then, I was interested in model airplanes and automobiles, things mechanical, and I had my heart set on going to engineering school. I finally got in and had lots of starts and stops because of the war. I was at a prime age and those were tumultuous times. And before I finished, I decided to join the Reserves because I thought that would give me a good opportunity to finish school. Three months after I joined, I found myself at Fort Leonard Wood in combat engineers' basic training.

STOW: You didn't anticipate that, did you?

WHITMAN: Not quite. I had had ROTC basic training and just about finished it when I was sent to the Big Piney River to help build a pioneer bridge. You do that by cutting down trees, making logs, making foundations. I was a carpenter, and I was making beams out of round trees with an adz. I didn't cut and lathe, but I finished each beam. And, I've never forgotten this -- a lieutenant came up and said, "Are you so and so?" and I said, "Yes." And he said, "Well, we're going to send you to Grinnell College. I spent two days there, taking the toughest exams I ever had in my life in four-hour sessions. After that, I ended up on a train going to the University of Pennsylvania to study chemical engineering. I had almost finished mechanical engineering, so I said, “Well, it's a place to go. I'm in the Army. I'll do that.” I got there and they said, "Well, we're not teaching chemical engineering this year. We're going to start on mechanical engineering." So I said, “That's fine.” So, we started there. About three-fourths of the way through that, I had an interview with a Major Miller, and he said, “We're interested in putting you on a special project. You should join us, [because] this program that you're in is going to be terminated.” And I said, “Well, I'm used to terminated programs. Lead on.” That was on a Wednesday. On Saturday I got travel orders. There were three of us with orders, and the first sergeant said, “You're going to my hometown.” And I asked, “Where's that?” “Clinton, Tennessee,” he replied. Well, I had never been south of Fort Leonard Wood or the Ohio River. So I asked, “Well, what's going on?” He said, “I haven't the slightest idea, but they're building a town there.” So, I took a train from Cincinnati overnight and arrived in Knoxville about eight o’clock in the morning. I got on one of these articulated buses full of people and went to Oak Ridge. I had been on one of those buses before and didn't know it, in the Chicago World's Fair in 1934. That's where they got them. The Manhattan Project picked up anything from anywhere. And, when we got to Elza Gate, I thought, “Oh, my God, I'm back in Fort Leonard Wood in the Appalachians. This is the end! I've been snookered again.” So, when we went through the gate, I suddenly was disabused of the thought that it was a military base. There were civilians everywhere.

STOW: Yes.

WHITMAN: There were buses of people just scurrying around. And, we went to the barracks located across from St. Mary's Church and checked in. They weren't quite ready for us. And, I was an early member of the SED, so I didn't know anything it. This is an interesting story in itself. When the government decided to build the atomic bomb in 1942, they gave the job to the Army Corps of Engineers to manage it.

STOW: That's right.

WHITMAN: Leslie Groves was the second to be picked, but he took over. He had as his first lieutenant a Colonel Kenneth Nichols. When they started selecting contractors in Oak Ridge, they got a lot of complaints such as, "We can't get enough technical people."

STOW: Okay.

WHITMAN: So, Groves and Nichols had an idea. They asked the commanding general for permission to organize the 9218th Special Services Group. These people would be brought to Oak Ridge, put in with civilian employees, and given work to do. They didn't have to argue with draft boards. There was no deferment. You were in the Army and working for whomever.

STOW: But, you didn't get sent to Europe.

WHITMAN: I was going to say it was a bait, because the guys I was with went to Europe and managed to make D-Day in June of 1944. We all had basic training, we knew which end of the gun to hold, and we had done a lot of demolition work, but when we got to Oak Ridge, they had just started [to build] the barracks. In fact, they got here a day early and they didn't know what to do with us. So they said, "Well, you have the day off," and I hopped on a bus. You could get on a bus and go anywhere. And, [I] rode around the town and realized [how enormous was] the place. It was big. And, I saw these strange designations: Y-12, K-25, X-10. There were seven gates. You had to have a pass to get in and out. The other thing that blew my mind was that, when we got to the barracks, we had maids to take care of us. Can you imagine that?

STOW: A little like Europe. (laughs)

WHITMAN: Yes, it was a combination of different worlds. And, it was Nichols and Groves' idea to get people from all over. You go in the service from universities or wherever. They needed engineers, chemists, physicists and others, to staff the operations in Oak Ridge or Los Alamos, for that matter. So one morning, I got here about noon in Oak Ridge, and the next day, we just goofed off. I thought, "This is some assignment." The next day, I got on a bus to a place called Y-12. That was the end of recreation, believe me. I went into the North Portal by the small administration building --I can still remember every minute of it – and met William Chokley. He was the head of personnel for Tennessee Eastman and Y-12. I went into his office, sat down, and he said, "Young man, we're glad to see you. We need all the help we can get. I can't tell you what we're doing, but it is extremely important to the war effort. It could be a determining factor." Well, that sounded great. And, immediately I got shipped to the administration building in downtown Oak Ridge. Behind it were three training buildings, I think. And I went alone into a room and there was a calutron.

STOW: My goodness.

WHITMAN: A "D." And, I learned new language. Everything was not called by its generic name. A calutron was a "D." A filament was a "K." An ion chamber was a "J" and so on. And, I learned everything there was to know about this thing and whatever it did. (laughs).

STOW: They had just one calutron?

WHITMAN: There it was, to take apart and put together. I became a mechanic. I started from the bottom. (laughs) They were in desperate shape. You know, we were at war in the Pacific, the Atlantic, Europe, and Asia. Our industries were going full tilt and here we were starting on this Manhattan Project.

STOW: Now, when you saw this calutron and started to learn to work on it, did you have any idea what it was being used for?

WHITMAN: Absolutely none! Oak Ridge is the largest collection of reasonably intelligent people that had ever been assembled who didn't know what they were doing -- and boy, I fell right into this category. (laughs) When I saw this thing, I had no idea [what it could do]. It was an extremely complex device.

STOW: Oh, yes. We have one over at the museum.

WHITMAN: And, back in the old ones, the filaments had rather short lives because of ion bombardment. So, they had remote devices to change the filaments, clean the slits, adjust all the accelerating geometry, and …

STOW: So, how long did you train before you actually worked on a calutron …

WHITMAN: Two weeks! (laughs)

STOW: Two weeks of training, and then you got put in what?

WHITMAN: 9201-2, the Alpha Building.

STOW: All right.

WHITMAN: And, Alpha-1 had started up and had to be shut down because of dirt in the magnet oil. They started up two calutrons in early '44 and I arrived there in late March. And, everything was kind of bustling. I got put in the mechanical assembly group, taking these parts and putting them together. Y-12 was in a terrible bind back then because there were failures right and left, and there were lots of operational difficulties. These things were kind of complex to run. I worked on the mechanical assembly business for a while. The big bushings in the calutrons back then were designed to handle about 50,000 volts at three-and-half (3.5) amps. Sometimes they failed in a spectacular fashion. When a unit was in operation and a bushing failed from stresses or other factors, there were lots of fireworks.

STOW: I can imagine there was.

WHITMAN: A lot of fireworks. These things were soldered in, [making repairs] a terribly difficult job. You had to wrap the thing in wet cloths and do it quickly. If it was too hot, it would break. I did that for a while, and then I got transferred to operations. And, I learned how to operate these beasts. I became a "track foreman." I had 48 cubicles that I had to look out for. I [supervised] 50 girls, five startup men, electricians, maintenance men… I was 24-years-old. (laughs)

STOW: But, by then you probably had an idea of what was going on, didn't you?

WHITMAN: I have to tell you this. I was coming back from the Y-12 cafeteria one

night and headed towards the dispensary were two MDs ahead of me. And, they were talking about heavy metal poisoning and its effect on kidneys.

STOW: Yes.

WHITMAN: And they mentioned uranium -- loose lips.

STOW: Is that when it dawned on you?

WHITMAN: That was when it dawned on me. You know, they had never mentioned the word uranium before.

STOW: No, that's right.

WHITMAN: Never! I'll have to tell you another story about when the magnets were shorted out and failed. Well, let me back up. There were four military groups in Oak Ridge. There was a Manhattan Engineer District that ran the place. There was the military police who policed the place and kept law and order.

STOW: Sure.

WHITMAN: There was a Special Engineer Detachment, which [consisted of] about 1,250 people at its maximum strength.

STOW: That's the SED.

WHITMAN: That's the SED. And then there was the counter intelligence corps, about 350 strong. They were all over the place. They were in every Y-12 production building in the magnet filtration and pumping system because that was such a sensitive area. If anything ever happened to that equipment, the whole building would be shut down. That's what happened when dirt got into the magnet oil -- they suspected sabotage. One of the reasons they did was [the discovery of a] down stem welded to a packing gland. The cause was just an arc strike; it was an accident. But, anyhow, they made a big-to-do about it. Well, these counter intelligence people were present throughout these buildings. I worked with one for four years and never knew he was in the corps. And, they kept track of your behavior.

STOW: Yes.

WHITMAN: There were several things that impressed me at first: the intensity of the activities and the size of the plant. Y-12 was two miles long.

STOW: Yes, it's a huge place.

WHITMAN: Some 22,500 people scrambled around in there. You were designated to work in a certain area, encouraged to learn everything you need [to know] to do your job, and discouraged from learning anything else.

STOW: Compartmentalization.

WHITMAN: Compartmentalization. It was Grove's idea, as I understand. The other thing a lot of people don't know about back then was that we all wore uniforms.

Everybody in production, even the building superintendent, wore a uniform.

STOW: You mean a military uniform?

WHITMAN: No. A work type of uniform.

STOW: All right.

WHITMAN: If you were in process work, you wore a blue uniform. If you were a chemist, you wore a white uniform. If you were an electrician, you wore a green uniform. If you were a millwright or maintenance worker, you wore a khaki uniform. If you were in supervision, you had an epaulet and a ring around your shoulder.

STOW: I've never heard that.

WHITMAN: And, if you were a chemist and walked into my area, my first question to you was, "What do you need and what do you want and what are you doing here?" You stood out like a sore thumb.

STOW: Sure.

WHITMAN: (laughs) And, if he had business, you conducted business. Also, all the badges were coded. You had an "I" through "V" Roman numeral. If you had an "I," you knew where the dispensary and the restroom were. If you had a "V" you knew everything that God created.

STOW: And, what number did you have?

WHITMAN: "IV." Finally.

STOW: "IV." That's pretty close to the top…

WHITMAN: Finally. That took a long time. Anyhow, when I'd talk to you and look at your badge, I'd know what we could talk about immediately.

STOW: Yes.

WHITMAN: I would look at the color of your uniform and the Roman numeral on your badge. So, it was such a regimented thing and so carefully scripted. It was a great idea.

STOW: Well now, you mentioned General Leslie Groves.

WHITMAN: Yes.

STOW: And, Colonel Nichols.

WHITMAN: Yes.

STOW: Did you ever see them or have any interaction with them?

WHITMAN: I saw Groves several times. I didn't mean anything to him. He used to come marching through the control rooms at least once every few months, with his entourage

following him. He was a portly man. He never smiled and he walked along, looking like so-and-so. He had no idea that I existed, even though I was in the Army.

STOW: Sure.

WHITMAN: A lot of people didn't know we were in the Army because we changed clothes when we came in the plant. So yes, he came through many times, and it meant nothing to me except that he was in charge.

STOW: Well, let's leave the plant for a minute and go back to the city of Oak Ridge.

WHITMAN: Yes.

STOW: What were your impressions when you first saw Oak Ridge? You said how large it was and so on, but did you have any anticipation that you would spend the rest of your life here?

WHITMAN: None! None! Absolutely none.

STOW: In this "dog patch" of a city…

WHITMAN: Oak Ridge had a lot to offer in a different way. You know, everybody in Oak Ridge was from some place else. (laughs)

STOW: Yes.

WHITMAN: And there was a different kind of environment. Of the the guys I was in the Army with, one was from California, one from New York, one from Virginia, and one from Pennsylvania. I mean, we bunked together because I had a lot of shift work and we had to be isolated from the rest of the people so we could sleep. And, you never talked about your work.

STOW: That's right.

WHITMAN: I learned, I guess, about security. I asked one time, "Well, what would happen if I blabbed?" And, we had lots of meetings about that question. They said, "They'd send you to the Aleutians." Man, that impressed me to no end, because when I was in basic training, the lieutenant in charge of my platoon came from the Aleutians. And, he said it's a God-awful place. It's foggy, it's rocky, there's nothing there. It's cold. Don't ever go to the Aleutians. Well, I thought, "Golly, I don't want to go to the

Aleutians. And, I didn't know whether it was true or not. When the 509 group met in Oak Ridge, I gave a talk and we had a little session with the navigator on the Enola Gay [the airplane from which the first atomic bomb was dropped on Hiroshima, Japan].

STOW: Was that Dutch Van Kirk?

WHITMAN: Dutch Van Kirk. And, someone asked him about security. He said, "Well, it [was] very, very tight. We had a crew and they flew out to this pilot's hometown." And while they were there, he showed his mother and father the airplane. And, it was a B-25 modified for the A-bomb. When he got back, the next day he was gone. And Dutch said they asked about him and he said, well, he'd had a breach of security. A B-25 modified

for the A-Bomb was highly classified and no one but the people who knew about it could see it. You know where he is? He's in the Aleutians.

STOW: (laughs)

WHITMAN: So, they weren't kidding.

STOW: No, they weren't kidding.

WHITMAN: And, people did disappear from time to time.

STOW: Did you have any knowledge during 1944 and even into 1945 about K-25 and X-10?

WHITMAN: I only knew they existed, because I saw the buses designated [for these destinations].

STOW: So, you did know that you were working on uranium at Y-12.

WHITMAN: Yes.

STOW: Separating or enriching uranium-235.

WHITMAN: Q & R.

STOW: What's Q & R now?

WHITMAN: Uranium-238 and uranium-235 in Y-12.

STOW: Okay.

WHITMAN: All of the designations.

STOW: All right. So, you knew you were working on uranium-235, but did you know that it was to go into a bomb?

WHITMAN: Yes, but I didn't know. I went to the Oak Ridge library and found a textbook on physics by William Pollard [founder of Oak Ridge Institute of Nuclear Studies, predecessor of Oak Ridge Associated Universities]. I pulled it out, looked at the edges, and found the pages with darkened edges.

STOW: Yes, I've heard this somewhere.

WHITMAN: It's true. I did it. I opened it up and there it was. [I saw a statement on] the potential for splitting the atom for a weapon and the huge enormous energy that would be released. And, after I read that, the thing that concerned me was, "How would we ever deliver this weapon?" It would have to be a suicide mission. It could blow up the world. I had no particular training in atomic physics.

STOW: Everything kept going in, and nothing came out.

WHITMAN: There used to be 100,000-gallon tank cars of liquid nitrogen for every building. So, these were trains of liquid nitrogen coming into nine

production buildings all the time. There were carboys of acid, popes, pots, valves, this and that. Nothing [big] ever went out. Only teaspoonfuls left ...

STOW: Well, how did you hear about the end of the war when the bombs were dropped?

WHITMAN: I was at work and my boss's boss, Waldo England, a building superintendent and Eastman Kodak man from Rochester, told us. Even before this – let me back up on this. It's kind of interesting.

STOW: Okay.

WHITMAN: The bomb was dropped in August.

STOW: August 6th in 1945.

WHITMAN: In the first part of 1945, we were gathered together, some of us in Y-12, and there was a colonel from someplace and he said, "We're about to see the fruition of our work. We want you to make every effort to increase the output and we can reduce the quality a little bit," which can be done with a calutron. Jazz it up, run it full tilt, blow up the focus a little bit, and you can get a lot more output. We ran like that for three months. I mean, just hammer and tong. And, that was the material that went into the Little Boy.

STOW: The Hiroshima bomb.

WHITMAN: Yes. And, that's where it came from. We had enough for one bomb.

STOW: Well, yes.

WHITMAN: We worked night and day for two years.

STOW: Well, the world was very fortunate that the war ended when it did, because we didn't have material for another bomb.

WHITMAN: Yes, we did.

STOW: Oh, did we?

WHITMAN: Our nation had plenty of plutonium [produced at the Hanford, Washington reactors after researchers at the Graphite Reactor in Oak Ridge proved that plutonium could be made in a reactor fueled with natural uranium]. We could turn out one, I think, every two weeks. We had two in reserve

STOW: No more uranium, right?

WHITMAN: No more uranium. The uranium was …

STOW: Well, you were starting to tell me about how you heard about the end of the war.

WHITMAN: Well, I was at work and I think they announced it over the radio in Knoxville or in a special edition of the newspaper that came out early. My boss came out and said, "They've done it. They've dropped the bomb." He spent the rest of the afternoon trying to figure out how much had been put in it. There was a big question back then what a critical mass would be [the amount of enriched uranium needed for nuclei undergoing fission and releasing neutrons to sustain a chain reaction that unleashes huge amounts of energy].

STOW: Oh, yes. They didn't know.

WHITMAN: They didn't know. They guessed from 100 to 1000 kilograms [of enriched uranium]. I think it's been argued that the Japanese and the Germans may have reduced some of their activities because of estimations of the critical mass required. Whether that's true or not, I don't know.

STOW: I don't know about that. Did you realize at the time you heard about the dropping of the first atomic bomb that you had been a part of the process to produce that weapon?

WHITMAN: I sure did.

STOW: How did you feel?

WHITMAN: I was very proud. I lost a lot of friends in the war.

STOW: I don't doubt you did.

WHITMAN: It was a big moment.

STOW: Now, what did you do the next day after this?

WHITMAN: Went to work.

STOW: Did they continue to produce …?

WHITMAN: Absolutely. Full tilt. And then shortly after that, they started phasing out [enriched uranium production]. I got transferred to a Beta building for a while and worked there. Then, I got into stable isotope [production using the] calutrons. I went through the periodic chart [trying to produce isotopes of every element].

STOW: You worked with Chris Keim?

WHITMAN: Yes, Chris Keim, Leon Love, and George Banic, who knew more about calutrons than E.O. Lawrence. I met E. O. Lawrence.

STOW: Did you?

WHITMAN: And, two other people. Edwin McMillan and another Nobel Prize winner. The calutron was Lawrence's baby. That's why he and his colleagues were interested in observing the operations of Y-12's calutrons. And, some of their graduate students came here at special times and gave us instruction on advanced calutron design and operation. And, we had a group of people in cubicles devoted especially to new

designs. We were assigned to work there for a week on these designs and calutron operations with Lawrence's graduate students.

STOW: My goodness.

WHITMAN: And, twist the knobs with them.

STOW: Well, they ran out of copper at Y-12 and had to go to the Treasury Department and get almost 15,000 tons of silver.

WHITMAN: The copper was never used because, Groves decided, that the amount of copper that would be required would [have to] come from South America, and they were worried about submarine interception and about the supply of ore. Copper was in short supply. So, they went to the Treasury [storage facility] at West Point to get silver. (laughs) There's a little story about that. They said, "We sell silver in Troy ounces. How much do you want?" And, they left with almost 15,000 tons! The silver was shipped to Allis Chalmers in Milwaukee, Wisconsin, where it was rolled into ribbons and then wound into the coils. After the war was over, the [magnetic coils for the calutrons] were disassembled and wound with copper, I think.

STOW: And the silver was returned to the Treasury Department.

WHITMAN: Yes, the silver was returned.

STOW: I don't think it got returned until the 1960s.

WHITMAN: Right. I know one of the guys in charge of recovering the silver, and that was an interesting thing. There were silver bus bars that [you could see if you looked] on top of a calutron unit and its tracks. When they were drilling the holes and tapping those bus bars, they had an armed guard picking up the shavings, making sure that it was all recovered.

STOW: Is that right? Well, I understand that virtually every ounce got returned to the Treasury.

WHITMAN: Yes. I don't know the exact number, but it was a very small amount of silver that was lost from the operation of the calutrons. Well, there's still a building -- Beta 3 – but no equipment is in operation there. I think the magnetic coils were rewound [with copper]. I don't know.

STOW: Let's talk a little bit about the Stable Isotopes Program that came along after the war. You got transferred to ORNL in 1947.

WHITMAN: Right.

STOW: And, when did the Stable Isotopes Program get started?

WHITMAN: About that time. Chris Keim was the first director and he said, "We're going to work our way through the periodic chart." I had a course in heat transfer -- one of the first courses taught. The first I think was at MIT from McAdams, and I had Professor Marco at Ohio State University, who wrote a book [on heat transfer] by Brown and Marco. I took the second course he taught. I did a few little calculations on

ion forces. When we started on the Stable Isotopes Program, every element had a new problem.

STOW: Sure.

WHITMAN: You had to have a charged material. You had to design a receiver. Because tin has 10 isotopes, you had to collect them in 10 different receivers and so on. And each element required a special design for an ion source and a charged material and temperature that were practical for heating it to get enough vapor pressure in the ion chamber to ionize the material.

STOW: Okay.

WHITMAN: I worked on the Stable Isotopes Program until we got through the periodic chart. (laughs)

STOW: Where did you start -- with hydrogen?

WHITMAN: I don't remember. I think sulfur or something like that. These were starting materials for cyclotron bombardment for medical purposes. That was the primary usage I got assigned to. My first project involved a small quantity of uranium that had minute quantities of uranium 236 in it.

STOW: Okay.

WHITMAN: They wanted the U-236 separated out. They wanted it enhanced, and with a mass spectrometer you can do a good job. So, we designed a small calutron and took this small quantity of U-236 in with the U-238 and separated it out.

STOW: Amazing.

WHITMAN: Milligrams.

STOW: Atom by atom.

WHITMAN: Atom by atom. And, it was very successful. We did the separation in one pass. That was my first opportunity to work on a project, and it was great. It had a beginning, work, and an end.

STOW: Well, how long did you work on the Stable Isotopes Program?

WHITMAN: About seven years. I started in '47 and it went to '54 when I went to the ANP Project.

STOW: Yes. The Aircraft Nuclear Propulsion project.

WHITMAN: ANP. The "grocery business." The Navy had a nuclear submarine and the Air Force just needed to have a nuclear-powered aircraft.

STOW: There was some competition there I understand. Admiral Rickover didn't seem to think we could get a reactor into a submarine.

WHITMAN: (laughs) So, there were two concepts. General Electric used the direct cycle [in which] fuel elements cooled by air drove a jet engine. And, ORNL, under R. Pross, Bo [R. C.] Briant, and others, [selected] a liquid nuclear fuel to heat liquid metal, which transferred its heat to air to run a jet engine. What a concept. It ran, believe it or not, at 1500 degrees Fahrenheit, which is hot.

STOW: Yes, it is.

WHITMAN: We used the first molten salt -- a combination of beryllium, sodium, lithium, fluorides, and uranium -- to make a liquid fuel. The fuel ran at high temperatures, transferred its heat to a liquid metal coolant, which transferred its heat to air, to run a jet engine. That was the idea. We built an aircraft reactor experiment. **It** ran up to about 2.5 megawatts at those temperatures. And, it was beautiful. All you had to do to control it was cool the fuel and -- swish! It would just accept the load. It had a temperature coefficient, which allowed it to stay critical, and you could just drag more heat out of it.

STOW: Physically, how large was that reactor?

WHITMAN: It was about four or five feet in diameter and about six feet tall. It had Inconel tubing. It was moderated by beryllium oxide, which we had machined under kerosene coolant in Y-12 shops. You could do anything at Y-12. And, the ANP reactor was assembled where the Molten Salt Reactor was finally built. We ran it for about a week.

STOW: All right.

WHITMAN: And, we demonstrated that it would work and shut down. Of course, it was a very dangerous operation.

STOW: Well, I was just going to ask you about safety in those early days.

WHITMAN: I met Morgan.

STOW: Karl Morgan, the well-known health physicist?

WHITMAN: Karl Z. Morgan came out and put a counter on my thyroid [to check for the presence of radioactive iodine]. We were the first guinea pigs because we had worked on one of the earlier reactor types. And, so I remember he came out and took a count of my thyroid. (laughs)

STOW: Well, what was your reaction to that?

WHITMAN: Well, I was flattered that he would …

STOW: Well, were you worried at all?

WHITMAN: I don't know. Not really. I guess I was just young and adventurous. I thought it was great. Bill Cottrell, Bob Affel, and I were the operating superintendents. Larry Mean gave us a course in nuclear engineering. There was no ORSORT (Oak Ridge School of Reactor Technology) back then. And we went to the Bulk Shielding Reactor and did a critical experiment.

STOW: A critical experiment?

WHITMAN: Yes. We loaded the BSR with enough uranium to achieve criticality and took it to power, from scratch, as students. We had to make all the calculations and he gave us a [grade] … So, I was in the first class of ORSORT and never knew it.

STOW: I guess that's true, isn't it?

WHITMAN: Larry Mean taught the course. He was from the University of Virginia. He left, and Ed Bettis and Ray Mann became the supervisors of training. Bob Affel, Bill Cottrell, and I were the operating supervisors on each of the shifts.

STOW: Well, this Aircraft Nuclear Propulsion Program was here for several years, wasn't it?

WHITMAN: That's right. I think there were two reasons why it went down [in 1961]. First of all, missiles became operational and the mission for the nuclear-powered aircraft wasn't quite as important. However, I think people suddenly woke up to the fact that it would be very troublesome [if an airplane powered by a nuclear reactor crashed].

STOW: Well, the shielding of it …

WHITMAN: And, the shielding was a problem relative to the crew.

STOW: Yes.

WHITMAN: There was even a design that was "tug tow." You put a reactor up here and put a cable back to the controls to fly it. But shielding was a problem. [It had to be thick enough to protect the crew from the reactor's neutron radiation but not so heavy that the plane couldn't fly.] I got to see a B-36. That was the airplane that was designed to bomb Germany [after being flown] from the United States. And, we had gone to Wright Field on a couple of occasions [as representatives of] the Aircraft Nuclear Propulsion Project to see some of these aircraft. I got in a B-36. It had six pushers, counter-rotating or reciprocating engines for propellers, four turrets, and a bomb bay that you could hold a college prom in.

STOW: (laughs)

WHITMAN: I got in this thing and sat up in the pilot's cockpit. Over to the right was the engineer's control panel, which had all the instruments. When everything was turning and burning right, all the needles pointed straight up. I know the pilot said, "I've got six turning and four burning, so I'm ready to go." Well, that was one of the airplanes they were considering for the reactor.

STOW: I had never heard of that.

WHITMAN: All this work would have to be done remotely.

STOW: Sure.

WHITMAN: And, they had done a lot of work on that. There was work going on all over.

STOW: But, that program, while it eventually died, really gave birth to an awful lot of other programs.

WHITMAN: Exactly.

STOW: Can you expand on that a little bit?

WHITMAN: Well, first of all, there was the Molten Salt Reactor. Also it brought out a new class of materials. Bill Manly …

STOW: Yes, we've talked to Bill.

WHITMAN: I worked for him. He was instrumental in [promoting the development of Inconel alloys and similar materials, as well as materials used] in high-temperature boilers today. This was great. [A lot of welding procedures and techniques for inspecting welds] were developed. You can imagine the thousands of welds in that thing. You had to have zero leakage or you'd be in a bad way.

STOW: Sure.

WHITMAN: A little story …

STOW: Okay.

WHITMAN: Ed Bettis and Bill Manly were in conversation, and Bill said, "You'll never build this reactor without having at least one leak." And Ed said, "Well, we'll do it." We had a leak. (laughs) Bill won the bet.

STOW: And, did the leak result in any problems?

WHITMAN: No real catastrophe. It happened on my shift. We had a little sodium leak so we shut down the reactor and put out the fire. I spent a lot of time fighting sodium fires. I built the first high-temperature heat exchanger using sodium heated up to 1500°F. We used a concept that was new and different. We got a welding transformer from Y-12 and passed the current directly through the pipe and the sodium. We could heat that stuff and take the load as desired. It was just like a reactor.

STOW: It liquefied immediately, right?

WHITMAN: Well, it could be heated and we could take it as fast …

STOW: You worked on a number of different reactor projects here.

WHITMAN: Yes.

STOW: The Experimental Gas-Cooled Reactor?

WHITMAN: The EGCR. I started there with Mike Bender and we had the job of monitoring the construction, which was done by H. K. Ferguson. And, the design … It was a design nightmare. Part of the design was done by Kaiser in California.

STOW: Yes.

WHITMAN: Allis Chalmers in Connecticut and ORNL designed the fuel elements, the control rods, and the core.

STOW: (laughs) Yes.

WHITMAN: So they had to integrate all these things. We spent time in California at meetings … Leroy Jackson, who was head of construction for the AEC back then, was over the gaseous diffusion plant. He was also in charge of the EGCR. We got it built with all kinds of features. It could be charged online. It had facilities for experimental loops. We had all the fuel elements built. We were ready to go critical and we had an ACRS meeting in Hanford, Washington.

STOW: What year would that have been, Grady?

WHITMAN: 1960 or 1961. I can't tell you exactly. That was my first experience with ACRS. I don't know if you ever heard of them.

STOW: ACRS?

WHITMAN: Advisory Committee on Reactor Safeguards. In order to run a reactor, you had to go before them and get a license. Well, it was very interesting because a number of the people on the ACRS had helped design this reactor. So, they had to recuse themselves from some of this. But, when we had our last meeting, the thirteenth meeting, reviewing the EGCR in Hanford, Washington, they gave us approval to load the fuel. Ah ha! We came back. Did you ever hear of Milton Shaw?

STOW: Sure, yes, with the AEC.

WHITMAN: Well, he was in charge of the reactor business back then, including the reactors for the aircraft carriers.

STOW: Yes. He crossed swords with a number of people, didn't he?

WHITMAN: Indeed, he did. And, when he crossed swords with you, you knew you'd been crossed.

STOW: Yes.

WHITMAN: Well, anyhow, I knew him pretty well. And, he came out and said, "Well, I know you've done a good job, and you're ready to go critical. But, we're going to shut it down." (laughs) He said, "We've got other fish to fry. We can't afford the expenditure of any more funds on this concept." He said, "I don't think a gas-cooled

reactor can compete with water reactors economically." So, we disbanded the EGCR project.

STOW: What did the Laboratory director have to say about that?

WHITMAN: Well, Alvin Weinberg, I don't think, was ever too keen about gas-cooled reactors.

STOW: Yes.

WHITMAN: I thought he used to say gas was a little tenuous to take heat off a fuel element. He had recommended pressurized water reactors [for powering submarines and ships] to Hyman Rickover [of the U.S. Navy] when Rickover was chief over here in the ORSORT reactor school. Alvin had a strong bent for liquid fuels and he was interested in pressurized water reactors. I was in an information meeting at Y-12 once. Can you imagine this? Rickover and Weinberg were there.

STOW: Two strong individuals.

WHITMAN: (laughs) And, I remember Alvin asking Rickover if he had ever considered a breeder reactor. And Rickover said, "We'll do all I bid you, sir, in the Navy."

STOW: (laughs)

WHITMAN: (laughs) And, it brought down the house.

STOW: I'll bet it did. I've never heard that before, and we've talked to Alvin about his interactions with Rickover.

WHITMAN: Yes. We used to go to Washington to see him when Milton Shaw was head of the AEC's Heavy-Section Steel [reactor vessel] Program. He ramrodded that. And, Joel Witt and I used to go up there and sit in Admiral Rickover's desk and chair. He had an office at 1414 K Street, I think.

STOW: Yes.

WHITMAN: We used to sit at his desk and give each other orders. (laughs) You'd have to know Rickover. He was apparently something else.

STOW: Apparently, he was.

WHITMAN: I knew more people that got involved with him. And, you wouldn't believe it, but it's true, I guess. He ran a tight ship.

STOW: Yes, that's what I understand. He got what he wanted, too.

WHITMAN: And, Milton Shaw was one of his lieutenants responsible for the design of the reactors for the aircraft carriers.

STOW: Yes.

WHITMAN: Shaw's people sponsored the Heavy-Section Steel Program, which was Bill Manly's idea. That's an interesting story in itself because, here we were building these huge reactor vessels [made of heavy-section steel] for light-water reactors, both pressurized and boiling, and we really didn't know that much about the behavior of the steels. So, Bill Manly wrote a letter to the ACRS and suggested that a program be undertaken to extensively study low-alloy steels.

STOW: Yes.

WHITMAN: Their physical properties, their properties in neutron bombardment, etc. And, that's how the Heavy-Section Steel Program got started.

STOW: Interesting.

WHITMAN: I got the job of writing a report. I didn't write it. I had 15 authors. It was called the *Pressure Vessel Technology Report*. We got to go all over the country and talk with the experts [so we could] put this volume together. And, then we got the job working with the Heavy-Section Steel Program. And, that was an exciting program -- one of the best programs I ever worked for.

STOW: I want to ask you about what your favorite job was.

WHITMAN: Well, that was one of the favorites. I had a lot of favorites. I will always treasure the days when we were working on the early reactors. I didn't know that much about them, and you'd just start from scratch. When you just turn a little knob, you can drive power up to megawatts. It's kind of awesome.

STOW: **It** gives you a feeling of power, I guess.

WHITMAN: Of feeling power. And, you can't appreciate it until you do it. And, you know, small quantities of nuclear fuel [produce lots of power].

STOW: What would you say you're most proud of as you look back at your career at Y-12?

WHITMAN: Oh, I think the Heavy Section Steel Program. It really did provide information for the pressure vessel codes. Section VIII, Section X, Section IX all give rules for radiation damage. We irradiated the largest compact steel specimens that were ever [exposed to radiation] in the world.

STOW: How large would that be?

WHITMAN: Oh, so many feet. And, they were irradiated [with neutrons] in the Bulk Shielding Reactor. Ray Bergman and Dominic Canonico designed equipment to irradiate these huge specimens -- the largest that had ever been built. Weirradiated them to high effluence and studied their fracture properties [ability to resist cracking under different conditions]. We tested them at Hanford in the hot cells out there.

STOW: They irradiated them here and transferred them to Hanford.

WHITMAN: Yes. And, that was a problem in itself. We tested some [large specimens] at Westinghouse in Pittsburgh and some of the smaller ones here. But, they were hot and

had to be dealt with. We determined the first fracture properties of low-alloy steel in the world. And, [our data are] still in the codes, which give recommendations. You use Charpie's specimens to monitor pressure vessel steels today. They're little bitty things that you impact, providing a measure of their fracture toughness. And, if the temperature is too low or they behave as if they are brittle, in a frangible fashion, then you could be in trouble. That was the worry about the HFIR (High Flux Isotope Reactor, which was shut down in 1987 because of concerns about brittleness in the reactor vessel wall materials]. One of the things that we discovered back when we were welding steels was that putting copper over the welding rod prevented it from corroding and also improved its conductivity. Well, copper was good because it improved the strength. However, under neutron bombardment, copper enhanced embrittlement [of the reactor vessel's steel alloy wall].

STOW: It increased the embrittlement of the steel.

WHITMAN: Exactly. Right around the belt. The Russians had a reactor over in Finland that was made of glass. The Russians' designs were very compact. They took their civilian power reactor out of the submarines, and the walls of the vessel suffered great radiation damage. The Russians never acknowledged it. (laughs) No problem. But, the Heavy-Section Steel Program was an international program. We worked with all our enemies. We had exchanges with Germany, Japan, Italy, France, Great Britain, Norway, Sweden, and Russia. We met people from all over the world and worked on things of common interest, including the safety of reactors.

STOW: I can see how you'd be most proud of that.

WHITMAN: And, I certainly didn't dream it up. I was a Johnny-come-lately. Joel Witt had a lot to do with the design, the concept of some of the work. We got to work with some of the pioneers of fracture. I worked with George Erwin. He was the deity of fracture mechanics.

STOW: Okay.

WHITMAN: I worked with Paul Paris, who was a world authority on fatigue crack proofing. They were authors in our report and were consultants to us, and we would exchange a lot of ideas with them.

STOW: Well you've thrown a whole lot of names out here, some of which I recognize, some of which I don't. But, as you look back over your career and think of the people you've worked with or for, who might have influenced you the most? Whom do you have the highest regard for?

WHITMAN: Oh, I don't know. I liked Bill Manly. I thought he was a gung-ho guy that got things done. He was very smart.

STOW: We lost Bill about a year ago.

WHITMAN: I know, I know. He helped me a lot. He was a Marine.

STOW: Yes.

WHITMAN: And, I just enjoyed his company, his intellect. I got to work with him a little bit when he went to Boston and worked with Bob Charpie [at Cabot Corporation]. Bob Charpie was the director of the gas-cooled program when I worked on the EGCR.

STOW: Yes.

WHITMAN: I couldn't keep up with him for a minute.

STOW: I heard a lot about him.

WHITMAN: (laughs) He was quite a guy. He and Bill Manly were buddies. And, I thought really highly of him. But, you know, the one person we all admired obviously was Alvin Weinberg. My goodness. It always used to worry me when we had our information meetings. Alvin would always sit in the front row and ask questions. And, I learned a long time ago to never tell Alvin anything I couldn't back up or derive, because he'd crucify me if I didn't. (laughs)

STOW: So, it's not unusual for you to say something about Alvin, as we have been talking to people doing this oral history program. At least half, if not maybe two-thirds of them, have independently said something positive about Alvin Weinberg and the impact that he's had on their careers.

WHITMAN: Absolutely. He was, you know, just an inspiration to be around.

STOW: If you could go back and do anything differently …

WHITMAN: Oh, my goodness … (laughs)

STOW: What would you do differently?

WHITMAN: Well, this is out of the woodwork, but I might be interested in medicine. (laughs) But, I don't know why. It's fascinated me over the years. And, the work that health physicists do interests me. Not that I could do it. When I was in college, I worked in the hospital for my meals. And, back then, I waited tables for the doctors.

STOW: Okay.

WHITMAN: But, I don't know why -- I may not have had the right temperament. But, it was just something to think about.

STOW: What if somebody were to do an interview 20, 30, 40 years from now, and your name came up in that interview. How would you want to be remembered?

WHITMAN: Oh, my goodness. Well, just as a contributor to [the advancement of the peaceful use of] nuclear energy. Nuclear energy has [contributed] to the betterment of mankind, in addition to being a weapon.

STOW: Yes.

WHITMAN: It is very important. And, I suspect, as Alvin Weinberg said, and I certainly agree with him, one of the real legacies of the Laboratory would be the [ORNL program that produced medical isotopes] --a legacy that will be forever.

STOW: Well, when you look back at the Laboratory, you remember it as a "temporary facility"

WHITMAN: Right.

STOW: Built here in 1943 and meant to be here for a year and a half. And, then the management realized that, "Hey, maybe we shouldn't make this thing temporary. Maybe we can produce some isotopes." And, that's how the resource started.

WHITMAN: Oh, it's a national resource of unbridled proportions. I had the opportunity to work in the management of a lot of work, and we had things coming in and out of the Lab. You could do anything at ORNL. If you had a problem, there was somebody at ORNL who could solve it for you. I didn't care what it was. And, we had a leg up on all of our competitors, because we had ORNL.

STOW: Well, that's probably still true today.

WHITMAN: Well, I'm sure it is.

STOW: But, there are rules and regulations today that won't let you do that.

WHITMAN: Well, yes. Yes, that's probably true. I guess we did a lot of shooting from the hip back then.

STOW: Do you feel that, in those early days, when you were "shooting from the hip," so to speak, do you feel that safety was compromised in any way?

WHITMAN: Well, Y-12 was a pretty dangerous place with its high voltages and strong magnetic fields. You had to be very careful, in addition to the safeguards that were there. But, there was a great urgency for production of nuclear fuel.

STOW: Yes.

WHITMAN: And, Y-12 workers could cut some comers. And, there were accidents. One guy who worked for me had to go in these tanks between the magnetic poles for one reason or another, and he came out screaming.

STOW: Screaming?

WHITMAN: He had been in the Italian campaign, was discharged from the Army, and had shrapnel in his right knee. He was in the magnetic field and that was pretty bad. [The magnetic field tugged on his shrapnel, causing pain.]

STOW: Oh, yes.

WHITMAN: But, we never even thought about that.

STOW: No, I would never have thought about that. There are stories about the hairpins for the ladies. [The strong magnetic field pulled the pins from their hair.]

WHITMAN: Oh, yes. And, we had beryllium and copper tools. If you were to go in the magnetic field with a tool made of a ferrous material, it could chop your fingers off. It was strong.

STOW: Is there anything else you want to add here, Grady?

WHITMAN: No.

STOW: Have we covered things pretty well?

WHITMAN: Well, sort of. Forty years is a long time. I had the good fortune to work on a lot of things, and I'm probably not qualified for any of them today. But back then, we were just doing with what we had. It's interesting. You know, we had no computers, only slide rules. Everybody had a slide rule [to do calculations].

STOW: Yes.

WHITMAN: I remember when the WANG came in. I had one on my desk.

STOW: It was a completely different world back then.

WHITMAN: I got a four-function calculator for Christmas from Carbide stores, and it cost $80.

STOW: That would have been in the '60s.

WHITMAN: Yes. It multiplied, divided, added, and subtracted. Wonderful!

STOW: And, now you throw something like that away.

WHITMAN: Yes. You can get one with your groceries. So, it's been an interesting ride, and I've enjoyed working in Oak Ridge. One thing I saw when I came here was that Y-12 and the Laboratory had a real potential because of the town, the people, and some of the interesting problems that existed.

STOW: Have you ever thought about leaving Oak Ridge during your career?

WHITMAN: Well, I had a couple of offers, but I didn't go. I just stayed. Of course, there was always something new and different around the comer. And, I like East Tennessee because it has a temperate climate. I remember the cold days. I came to Oak Ridge out of the north where it was a terribly bitter day. I arrived first in Knoxville. I had a wool sweater, shirt, and all this winter gear. I came off the train in Knoxville sweltering. (laughs) The sun was shining and the birds were chirping, and I thought, "I've arrived in heaven." And, we had maids at the dorm … (laughs)

STOW: What more could you ask for? Well, it's been a great hour talking with you. I appreciate it, Grady.

WHITMAN: Thank you.

----------END OF INTERVIEW----------