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NUCLEAR REGULATORY COMMISSION
REGION IV
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JAN 31 1990

MEMORANDUM FOR: James M. Taylor, Acting Executive Director for Operations

FROM: L. J. Callan, Director, Division of Reactor Safety, RIV
P. G. Brochman, Senior Resident Inspector, Clinton, RIII

SUBJECT: FINAL TRIP REPORT ON INSPECTOR EXCHANGE WITH THE USSR (JULY 8 - AUGUST 27, 1989)

Summary

We have successfully completed the US portion of first exchange of US and Soviet inspectors pursuant to Item 1.2 of the August 31, 1988, Protocol of the First Meeting of the US-USSR Joint Coordinating Committee on Civilian Nuclear Reactor Safety. We met with officials of the USSR State Committee for Supervision of the Safety of Work in Industry and Atomic Energy (previously known as GosAtomEnergoNadzor (GAEN)) at its national headquarters offices (Moscow), the Southwest Regional Office (Kiev), and at a site inspector office (Zaporozhe Nuclear Power Plant). A list of persons contacted is provided in Appendix A.

The purpose of this exchange was to develop an understanding of the methods used by the Soviets to ensure adherence to design and operational requirements and specifications for civilian PWR reactors. A detailed description of the specific objectives for the US inspectors is provided in Appendix B.

Conclusions

Our conversations with GAEN inspectors and supervisors were exceptionally frank and candid. This exchange was valuable in gaining insight into how GAEN functions, particularly regarding the role and function of the site inspectors. Our Soviet hosts were extremely hospitable.

At the site inspector level we found the GAEN inspectors to be very similar to NRC resident inspectors in their approach to ensuring safety. Safety was stressed over compliance, and the inspectors appeared to have enough independence to pursue whatever safety issues were identified. The GAEN site inspectors cover areas other than operational safety, and, in fact, the major focus of the inspection program is in the areas of engineering safety and technical evaluation.

The GAEN site inspectors have much greater authority than NRC resident inspectors, as they can issue fines and stop work on their own authority. They are heavily involved in the line process of running the power plant and approving procedures and authorizing maintenance activities. They are involved in post-event critiques and make recommendations for corrective actions.

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The differences between the NRC and GAEN become much greater at the regional and national levels. The GAEN system of enforcement is based primarily on personal rather than organizational accountability. As a result, investigations conducted by GAEN into technical problems and operational events typically do not address programmatic weaknesses such as inadequate procedures, training, or management oversight.

GAEN does not have an independent legal basis over the ministries it regulates but is on a coequal footing with them in the Council of Ministers. Consequently, regulations issued by GAEN must be concurred in by the affected ministries before they can be enforced against. For several of the organizations that GAEN must oversee, GAEN's authority is derived from the equivalent of memorandums of understanding rather than from a legal basis. The effectiveness of GAEN inspectors in resolving problems at the site is diminished as identified problems become more systemic or generic, requiring corrective actions to be implemented from the regional or national level. In particular, frustration regarding their perceived inability to correct identified design weaknesses and to influence the design agencies was voiced at all levels of GAEN. A more detail discussion of our observations and assessments is contained in Appendix C.

As an overall conclusion, GAEN is viewed as a positive force for improving the safety of Soviet PWRs. However, GAEN is still a relatively young organization and its recent (August 1989) reorganization/merger with the Committee for Mining Safety may dilute GAEN management's ability to focus attention and resources on nuclear power plant safety issues.

Recommendations

1. The inspector exchange program should be continued for at least one more year; however, the length of the visit should be shortened to a maximum of five weeks.

2. Future Working Group 1 activities should include increased focus on GAEN regional inspection and assessment functions. At the national level, Working Group 1 should explore GAEN's interactions with design organizations.

L. J. Callan, Director
Division of Reactor Safety, RIV

for P. G. Brochman, Senior Resident Inspector
Clinton Power Station, RIII

Appendices:
A) List of persons contacted
B) Inspection objectives
C) Detailed observations, findings, and conclusions
D) Translations of Soviet media articles

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APPENDIX A

LIST OF PERSONNEL CONTACTED

A. GAEN National Headquarters (Moscow)

1. V. Malyshev, Chairman,
2. N. Steinberg, Deputy Chairman
3. A. Mazalov, Deputy Head, Operations Department
4. A. Gutsalov, Head, GNTU
5. A. Khamaza, Director of International Programs

B. GAEN Southwest Regional Office (Kiev)

1. A. Demyanenko, Chief Administrator
2. A. Kordyuk, Deputy Chief Administrator
3. Y. Batrak, Deputy Chief Administrator, Chief Regional Inspector for Design and Manufacturing of Nuclear Industry Equipment
4. V. Stetsenko, Deputy Chief Administrator, Chief, Division of Foreign Inspector Specialists
5. V. Khromov, Chief Regional Inspector for Operations and Outage/Repairs
6. A. Manko, State Regional Inspector for Operations
7. N. Nigmatullin, State Regional Inspector for Operations
8. V. Stovbun, State Regional Inspector for Operations
9. A. Koretsky, State Inspector
10. Y. Krokhmal, State Inspector
11. V. Novikov, State Inspector
12. A. Uskov, Senior Specialist, Foreign Inspector Specialist Training Group
13. V. Efimenko, Assistant to Valentin Stetsenko

C. GAEN Site Inspector's Office (Zaporozhe Nuclear Power Plant)

1. V. Koltunov, Chief Inspector
2. I. Atakishev, State Inspector
3. V. Dobrynin, State Inspector
4. V. Golosenko, State Inspector
5. L. Golovko, State Inspector
6. V. Lukin, State Inspector

APPENDIX B

Specific Objectives for US Inspectors Participating in The US/USSR Inspector Exchange Program

Background

Item 1.2 of the Protocol of the First Meeting of the Joint Coordinating Committee for Civilian Nuclear Reactor Safety proposed that the US and the USSR establish a means for each side to develop an understanding of the other's methods used to ensure adherence to design and operational requirements and specifications through an exchange of inspectors.

The goal of the US/USSR Inspector Exchange Program is to develop knowledge of the safety culture of the Soviet commercial reactor program through an understanding of licensee/operator and regulator/inspector methods for ensuring adherence to design and operational requirements and specifications. It is expected that the participating inspectors will return with a basic understanding of regulatory and inspection procedures, and inspector and operator safety approaches in the USSR. The goal is for the participating inspectors to obtain this understanding to the degree necessary to accurately describe the program to their peers upon their return.

Specific Objectives

1. Develop an understanding of the relative roles and relationships among the various governmental organizations involved with nuclear power generation.

   - What are the inspection program objectives, methodology, and products?
   - What is the relationship between inspectors and the plant staff?
   - How are decisions made regarding the planning of inspection activities and the allocation of inspection resources?
   - Are inspectors compliance oriented or safety oriented?
   - Reactive vs. proactive role of inspectors.
   - Procedures used by inspectors when they identify a problem.
   - "Enforcement" authority of inspectors.
   - Which government organization do the inspectors work for, and what is their reporting chain?
   - How do other government organizations impact the inspectors' responsibilities?
   - How are areas outside the inspectors' expertise inspected?
   - What inspection guidance/program direction exists?

2. Identify strengths in the Soviet system that might be used in the US to improve our processes and programs, and conversely identify aspects of the US inspection program which might be implemented in the USSR to improve Soviet regulatory procedures and programs.

3. Communicate to the Soviets how our inspectors do their job.

4. Develop an understanding of and insights into various aspects of the Soviet commercial nuclear power program:

- Design philosophy as evidenced by the design and safety features of the visited reactor plants.
- The degree of plant management oversight of safety-related activities.
- The scope and depth of operating and emergency procedures.
    - Adherence to procedures/controls when deviating from procedures.
    - Procedures for effecting permanent and temporary changes to operating procedures.
- Characteristics of Soviet maintenance, surveillance and design change programs (including engineering support).
- The training and qualification of operators.
- The training of inspectors.
- The effectiveness of Quality Assurance and Quality Control Programs.

5. Identify any changes that should be made in the inspector exchange program.

APPENDIX C

DETAILED INFORMATION

1. Itinerary

7/8	:	Travel to Moscow, USSR, via Air
7/9	:	Arrive Moscow
7/10	:	Meetings in GAEN Headquarters
7/10-7/11	:	Travel to Kiev via Rail
7/11-7/13	:	Meetings in GAEN Southwest Regional Office
7/13	:	Travel to Energodar via Air, Bus
7/13-7/29	:	Meetings at Zaporozhe NPP
7/30	:	Travel to Leningrad via Bus, Air
7/30-8/8	:	Rest Period in Leningrad
8/8	:	Travel to Energodar via Air, Bus
8/8-8/21	:	Meetings at Zaporozhe NPP
8/21	:	Travel to Kiev
8/21-8/24	:	Meetings in GAEN Southwest Regional Office
8/22	:	Travel to Chernobyl NPP via Ship, Bus
8/24-8/25	:	Travel to Moscow via Rail
8/25	:	Meetings in GAEN Headquarters
8/27	:	Travel to New York, NY, via Air

2. Observations of GAEN

Our observations are based on our close association with GAEN site inspectors over a four-week period while at the Zaporozhe NPP. Discussions and interviews with GAEN managers, supervisors, and inspectors at the national, regional and site levels supplemented our field observations. All of these interactions were exceedingly frank and candid and were very informative. Our meetings in the GAEN national headquarters (Moscow) and Southwest Regional Office (Kiev) dealt with GAEN's structure, mission, and the implementation of the regional inspection program. While at the Zaporozhe NPP we focused on the implementation of the GAEN site inspection program in the field.

A. GAEN Regional Activities

GAEN has five regional offices. The Kiev region is considered a "complex" region, in that it has responsibility for inspecting design agencies, fabrication facilities and reactor sites (operating and construction). Only the Kiev and Moscow regions are considered complex regions, as the other three regions do not have any reactor site oversight responsibilities. The Kiev office is organized under three broad areas: operational safety (operating reactors), equipment safety (construction, installation, pre-op testing), and design and fabrication facilities. Additional responsibilities include the coordination of onsite reactor inspection activities and the training of inspectors. There are seven sites with operating reactors and three sites under construction in the Kiev region. Three of the 7 operating sites have additional units under construction, yielding a total of 22 operating units and 13 units

under construction. These include various sized VVER and RBMK reactors.

The Kiev region oversees 32 maintenance organizations, 110 organizations involved in construction, installation, and pre-op testing, and 49 fabrication facilities and design organizations. To oversee all of these activities the region has a staff of 190 people plus 20 administrative workers. Each reactor site has from three to seven inspectors.

As part of its oversight process for support organizations, GAEN issues general and specific authorizations before they can accomplish any work. The organizations prepare documents for regional review that address the adequacy of staffing, required documents, tools and equipment, supervisory capability, material stocks and spare parts, and proper storage for the stock. After the region reviews this information, receives input from site inspectors, and sends inspectors to the facility (if necessary) a general authorization is issued.

General authorizations may be issued for as long as five years or as short as several months; however, only one has been issued for longer than one year by the Kiev regional office. Specific authorizations are issued by the chief inspector at the site before the activity is actually accomplished. Authorizations can be withdrawn if organizations do not perform acceptably.

The regional office approves the inspection program for the reactor sites and compiles quarterly reports for submission to GAEN headquarters on inspection program accomplishments and significant events. The region is tasked with providing event response teams and with reviewing the event investigation reports to ensure that the blame has been properly placed. Written procedures for performing inspections and the regulations to inspect against were shown to us in the site inspectors' office. The inspection procedures that we reviewed were significantly less detailed than comparable NRC inspection procedures. The site inspectors' office was located in the service building, which is inside the protected area.

GAEN also oversees the fabrication and manufacture of equipment used in reactor plants through the general authorization process. As a consequence of chronic quality control problems, GAEN now assigns resident inspectors at factories producing safety-related material for civilian reactors. In terms of manpower, the factory resident inspector program is almost as large as the reactor site inspector program in the Kiev regional office.

B. GAEN Site Activities

Zaporozhe was originally intended to be an eight unit site; however, Units 7 and 8 have been permanently deferred. Construction on Unit 1 was started in 1980 with four years being required to complete construction. Construction of additional units was begun at one-year intervals. At the time of our visit, Units 1-4 were operational,

Unit 5 was in the startup testing phase, and Unit 6 was in the construction/instaliation phase. The construction phase consists mainly of the structural work (structural steel, concrete pouring, etc.), while the installation phase consists of pipe welding, pump installation, electrical cable pulls, and sensor installation. During our visit, Units 1 and 2 were shut down for extended maintenance outages to replace the steam generators and Units 3 and 4 were in operation (Unit 3 shut down for a scheduled refueling outage halfway through our visit). Unit 5's initial criticality occurred while we were present in the control room on July 20, 1989. Consequently, we had a wide range of operating conditions and plant evolutions to observe during our visit.

There were seven inspectors assigned to the Zaporozhe NPP, and they conduct almost all of the inspections at the site. Only limited inspection support is provided by the regional office. One of the site inspectors was designated as the chief inspector. Five of the seven site inspectors were specialists in areas other than operations, and would have been assigned as region-based specialists if in the US NRC. The following areas are inspected by the site inspectors: operations, core physics (includes fuel handling evolutions), control and electrical distribution systems, engineering safety, construction, installation, and startup testing. As a consequence of assigning these resources to the site, the GAEN site inspector staff's breadth of expertise is much greater than a comparable NRC resident inspector staff. Radiological protection inspections are not performed by GAEN but are the responsibility of a separate state organization.

Several of the site inspectors had worked at Zaporozhe before they were recruited by GAEN. For example, the chief inspector had been at Zaporozhe since the construction of Unit 1 and had risen from auxiliary operator to the position of site shift supervisor (nominally number 3 in the operations organization) before he was recruited by GAEN. Some of the other inspectors had been assigned to different facilities, such as the Novovoronezh NPP, before GAEN transferred them to Zaporozhe. Inspectors are not rotated at mandatory intervals to other sites. In general, GAEN management was not concerned about the potential for conflict of interest.

These recruitment and staffing practices have contributed to the GAEN site inspectors having a more thorough knowledge of the facility than a comparable NRC resident office. The inspectors all have degrees from colleges or technical schools, most having graduated from the Odessa Technical Institute.

GAEN's scope of responsibility is larger than the NRC's as GAEN incorporates many of the functions which are part of a licensee's quality assurance organization at US reactors. Further, GAEN site inspectors have much greater authority than do NRC resident inspectors as evidenced by the fact that they have the authority to stop work and to levy fines against individuals for violations of rules.

As an example of this authority, the site inspector for construction activities stated that he had personally shut down inadequate construction work. Also, based on his knowledge of previous problems during construction he has required that fixes be made before problems occurred. He stated his philosophy was to try and prevent violations from occurring.

Maintenance activities are primarily done during outage periods; maintenance at power is minimized. Consequently, maintenance inspections are also done primarily during outages, as are the engineering safety inspections. The engineering safety inspections include activities that would occur in an ISI program in the US, but the Soviet program is more comprehensive. The engineering safety inspections constitute the major portion of the site inspection program.

GAEN has a policy of periodically sending site inspectors to other sites for inspections and assessments; however, the inspectors at Zaporozhe have been unable to participate in this policy due to their large workload.

The chief inspector is required to report to the regional and national offices by phone within one hour for any accidents which occur. A written report must be submitted by telex within five hours.

3. Observations of the Zaporozhe NPP

Though the principal reason for our visit was to improve the NRC's understanding of GAEN, we did make some observations of the Zaporozhe NPP as we accompanied the site inspectors on their tours. The Zaporozhe units are VVER 1000-model 320 pressurized water reactors.

Each VVER 1000 reactor unit is physically separated and independent from other units on the site. There are no shared systems. Some facilities, such as the spray ponds and radwaste buildings, are shared. There are three separate trains of engineered safeguards feature (ESF) systems for each unit, including emergency feedwater, safety injection, containment spray, emergency boration, and diesel generators. The diesel generators are located in buildings separate from the power block. Additionally, only two of the three diesel generators for a unit are located in the same building. The third diesel is located in a different building with the diesel generators from the next unit.

Containment penetrations, both mechanical and electrical, are separated by train. Containment fluid penetrations have three isolation valves, one inside and two outside containment. Containment penetrations typically are oriented vertically, rather than horizontally as is common in US PWRs. This vertical orientation is employed in the VVER design because much of the ESF equipment is located underneath the containment.

The three trains of ECCS (emergency core cooling system) use a common containment sump. Each train of the low pressure injection and containment spray systems has its own suction from this common sump with flow being directed through five inlet screens. The five screens associated with each of the sump suctions have sizes as follows: the first has 10x10 mm openings, the second through the fifth have 1x1 mm openings. GAEN has identified a potential problem with debris, particularly fiberglass insulation, plugging these sump screens. This would cause the screens to fail when the water backed up behind them. After the screens failed, debris could be swept into the suction of all three trains of ECCS pumps.

To verify if this postulated problem was a real concern, GAEN required the site to perform a full-scale, in situ test. This test initiated containment spray, simulating a large pipe break in the reactor coolant system. The result of the test was the failure of the low pressure ECCS pumps due to cavitation within 2-10 hours of introducing the debris into the area around the sump entrances. This test has been repeated at sites other than Zaporozhe as well, and the results have been basically the same. In less than 24 hours after the tests were started indications of cavitation were received from the low pressure ECCS pumps, and when the pumps were inspected fiberglass was found inside. There are approximately 33 VVER 1000-320 reactors which are operating or under construction which are subject to this potential problem. GAEN reached an agreement with the Ministry of Atomic Energy to build a scale model and conduct formal laboratory tests to validate the results of the in situ tests.

We toured the reactor protection equipment and ESF actuation equipment rooms. This equipment is also physically separated by train and by function. The cabinet doors were sealed with wax seals to provide indications of entry. The trip setpoints for the measured parameters were indicated on the doors of the cabinet.

We toured several of the control rooms. They were spacious and well lighted. The control room panels had excellent mimicking of ECCS systems and utilized numerous video screens to consolidate system information into coherent displays which the operators could readily utilize. The control room operators were professional and attentive to their duties. The layout and design of the control rooms were not radically different from US PWRs. While in the Unit 5 control room on July 20, 1989, we witnessed its initial criticality. All startups, not just initial criticality, are done with almost all control rods fully withdrawn, and boron is added or removed to control reactivity.

The Soviet operators rely on memorization of procedures rather than using prescriptive written procedures to accomplish operations. Written procedures do exist; for example, we were shown the emergency operating procedures in one of the control rooms (they were stored in a locked cabinet). The operating philosophy is that the procedures are there if an operator needs to refer to them, but he is expected to have memorized them. Additionally, unlike the prescriptive nature of operating

procedures in the US, we found the comparable procedures in use at Zaporozhe to be quite general, almost conceptual in nature. Since the operating procedures are written in relatively general terms and the operators primarily rely on memory to perform routine operations, minimal need was observed for temporary or permanent changes to written procedures.

We toured three containments (Units 1, 2, and 5). We noted that they had relatively low contamination and radiation levels. The radiation protection supervisor who accompanied us stated that the annual exposure per operating unit was a nominal 20 person-rem, which is considerably lower than exposures we have seen at US plants (it must be noted, however, that personnel dosimetry practices at Soviet plants appear to be less sophisticated than at US plants). The Soviets attributed the low contamination levels to the use of high temperature titanium filters for on-line filtration of the reactor coolant system and to the use of steel with low levels of cobalt impurities. Each containment has its own spent fuel storage racks, which have capacity for a nominal 15 years of operations. A separate spent fuel storage facility is also onsite to hold fuel removed from containment while waiting for it to be shipped offsite for reprocessing.

The Zaporozhe NPP does not appear to release any substantial amount of liquid or solid radioactive effluents to the environment. Solid radwaste is compacted or burned and the residue is then stored onsite. Liquid radwaste is evaporated and solidified and the residue is then stored onsite. The site has enough storage capacity to allow for its 30 year plant life after this reduction in volume. The radwaste building is almost as large as one of the power blocks.

The size of the plant staff is based upon a formula from the Ministry of Atomic Energy, with the major variable being the number of megawatts a unit has. Zaporozhe has approximately 1000 workers per unit. The construction work force for Unit 6 was approximately 8000 persons (down from 13,000 persons at the height of construction). These workers all live in the city of Energodar, which is less than 5 kilometers from the plant and has a total population of about 65,000. Energodar also supports approximately 4,000 Mwe of fossil fuel production located close to the nuclear plant site.

The Zaporozhe NPP is located on a promontory next to the Dneiper river and is quite sandy. Unit 1 has subsided into the sand approximately twice its design limit. This problem has not yet been analyzed and we were told it would not be addressed by the plant until after Unit 5 startup had been completed. An inspector told us that his apartment building in Energodar has subsided into the sand one meter since it was built approximately six years ago.

4. Assessment of GAEN

A. Strengths

GAEN's greatest strength is its people. The inspectors we observed were well qualified, proactive, and diligent in working to improve the safety of Zaporozhe NPP. They appear to have a strong commitment to safety. GAEN inspectors are not "code" inspectors, as nominally understood in the US, but have a much broader inspection authority. The inspectors we observed would routinely put in overtime to complete administrative paperwork, thereby ensuring that they had adequate time for getting into the plant.

GAEN inspectors have considerably more authority than do NRC inspectors. They can stop work and can personally fine individual workers and supervisors (including station management). Inspectors have approval authority over all procedures and in the commencement of all major activities (e.g., unit startups) and maintenance tasks. We saw evidence that this authority had been used to require various problems associated with Unit 5 to be fixed before it was allowed to enter its startup program.

The large onsite GAEN inspection staff allows for more specialization than at a comparable NRC resident office. The GAEN site inspectors have a broad scope of mandatory inspection activities, but they have also have the flexibility to "follow their noses" and correct safety issues. The inspection program followed by the inspectors is no more rigid than is the NRC's core inspection program at a resident site, and time is built into the inspection plan for event review and investigation.

GAEN has a system for collecting information on significant events which occur at sites, analyzing this information at the national level and then disseminating it back to the site inspector level.

B. Weaknesses

The chief inspector has significant administrative burdens (signature approval over all station procedures, etc.) which reduce his ability to conduct inspections. In some ways he was more of a chief administrator than a chief inspector. The administrative burden placed on the chief inspector took on added significance at Zaporozhe because he was one of only two operational safety specialists assigned to the resident office. In effect, therefore, only one operational safety inspector was working full-time at monitoring control room activities for the four operational and one startup units (and he was essentially preoccupied with the startup activities of Unit 5).

Compared to their ability to fix hardware deficiencies, the site inspectors feel relatively powerless and frustrated in their ability to have design weakness and problems corrected, especially on generic safety concerns.

A perception exists among some plant workers that GAEN exists to punish. Additionally, some workers have the perception that GAEN is responsible for ensuring quality and safety, rather than each worker doing his part to achieve these objectives.

By the NRC's standards, GAEN's close involvement in the line process of managing nuclear power plants may limit its ability to step back and objectively evaluate a problem and proposed corrective actions.

The Soviet philosophy of emphasizing individual accountability and stopping investigations of operational events when the "guilty party" has been found may limit the identification of any programmatic weaknesses, such as training or procedural inadequacies, thereby discouraging permanent solutions to problems.

GAEN does not have a legal basis to independently promulgate requirements to the ministries it regulates. Instead, GAEN is on a coequal footing with the ministries in the Council of Ministers, and regulations issued by GAEN must be concurred in by these ministries. Further, GAEN's reorganization/merger with the State Committee for Mining Safety may dilute GAEN management's ability to focus attention and resources on programs to ensure nuclear power plant safety.

C. Conclusions

GAEN operates more on the premise of ensuring safety by closely controlling all safety-related work and activities (the issuance of general and specific authorizations and permission to start) as opposed to the NRC's philosophy of using resident inspectors to independently verify the adequacy of a licensee's activities on a sampling basis.

The existence of GAEN has been a positive force at Soviet PWRs in all areas, including: design, fabrication, construction, installation, testing, and operations. GAEN has been most effective at correcting problems which are physically manifested (i.e., flaws in the manufacturing, construction, and installation processes) rather than at correcting problems which are related to the design process or are linked to organizational or programmatic weaknesses.

GAEN is still a young organization, and as a young agency its organizational culture is still evolving. Inspectors seemed to be not quite sure where they stand and how much support and backup they would receive if they should identify a significant generic safety concern which would cause the shutdown of multiple units.

5. Assessment of the Zaporozhe NPP

A. Strengths

The unit control rooms were run in a professional manner. The operators were alert and cognizant of degraded equipment. The level of plant cleanliness and housekeeping was generally adequate.

Senior management was observed to be present for significant tests or evolutions.

The levels of radioactive contamination in the plant seemed very low. In particular, radiation levels inside containment and around radwaste equipment were very low, even by new plant standards. These low levels may be partly attributable to the reactor coolant system's on-line, high temperature titanium filters. Further, representatives from the plant staff noted that the units were constructed with steel that had low levels of cobalt impurities by US standards. The processes for control of solid and liquid radwaste appeared to be very effective and were designed to eliminate essentially all solid or liquid releases or shipments from the site.

The physical layout of auxiliary building was very spacious and appeared to allow ample room to work on safety-related components. Safety systems are based on a three redundant train concept. Maintenance facilities were quite extensive, when compared to US utilities.

B. Weaknesses

The site manager and chief engineer (the number 2 manager at the site) were spread too thin trying to supervise five operating units, one unit under construction, and other activities.

Some of the plant staff voiced the perception that GAEN had the ultimate responsibility for ensuring safety of the plant, as opposed to acknowledging their own responsibility for building quality into the work they do. The prevalent philosophy for the conduct of operations places a premium on personal accountability. As a consequence, processes or programs designed to mitigate the results of inevitable human errors were not typically practiced. For example, written procedures were not routinely used by control room operators nor were checklists. Independent verification or "double checking" of activities were not observed.

The Zaporozhe site receives minimal operational support from offsite organizations. For example, when the construction and design organizations turned Unit 1 over to the operating organization to startup, there were effectively no operating procedures or equipment operating instructions. Design basis information needed to construct these procedures was also not readily available. This situation has improved somewhat for the follow-on units.

The training program for reactor operators has not been formalized, but relies to a large degree on an informal, subjective system of oral interviews. In effect, each trainee writes his own training program. Reactor operators typically are not examined on their knowledge of emergency and abnormal operating procedures during the qualification process. Zaporozhe NPP did not have a simulator but was in the process of procuring one from a US vendor.

Operators rely upon their memory to perform evolutions and respond to emergencies. Written procedures are available in the control room for the operators to refer to if desired, but the procedures are normally kept in a locked cabinet. The emergency procedures are event based and lack the detail and prescriptive guidance found in comparable procedures in US plants. Emphasis is put on a conceptual approach to accident response; consequently, considerable reliance is placed on the operators and senior operators to determine the correct course of action. The procedures are intended to be used as a guide rather than to be followed verbatim.

C. Conclusions

Operators were alert, professional, and cognizant of the status of plant and equipment. Extensive reliance was placed on memorization of procedures by the reactor operators. Checklists and independent verification of actions are not utilized.

There was no ongoing formal training program for reactor operators; however, operators were required to undergo requalification oral boards every two years. The Soviets license many more positions at their reactors than the US does. For example, key first-line supervisors in the maintenance department and various upper-level site managers are licensed. The training required for these positions is done on the individual's own time and consists of a qualification card requiring a series of oral checkouts followed by a final oral board.

The maintenance facilities appeared to be quite extensive and capable of repairing a broad range plant equipment failures. The maintenance philosophy at the site was to attempt to do the work during outages and to minimize maintenance activities when the unit is on line. The radwaste facilities were extensive and appeared effective in minimizing discharges and releases from the site. The physical layout of the plant allowed for ready access to and removal of equipment for maintenance.

Management involvement in plant activities was clearly evident; however, management may be spread two thin in trying to run six units.

6. Tour of Chernobyl

We briefly visited the Chernobyl NPP on August 22, 1989, and toured the towns of Pripyat, Salutavich, and Chernobyl. We met with the Chernobyl site manager and chief engineer who told us of some of the changes that had been made since the accident in 1986, such as increasing fuel enrichment to reduce the positive void coefficient. They also told us that the high speed scram system would be installed in Unit 3 this fall and that Units 1 and 2 would have their high speed scram systems installed within two years.

We toured parts of Units 1, 2, and 3, including: the turbine hall, Unit 1 control room, Unit 3 auxiliary building, and the Unit 4 monitoring room. We were unable to tour the area under the sarcophagus, due to core boring evolutions in progress. Site management told us that the collective radiation exposure had decreased from approximately 9000 person-rem in 1987 to approximately 6000 person-rem in 1988.

The Soviets have constructed the town of Salutavich to replace Pripyat as the residence of the plant workers. It is located approximately 40 km from the Chernobyl NPP and is connected by a newly built electric railway. To control the spread of contamination, workers change into their travel clothes before they board the "cold" train. The "cold" train takes them to the 10 km point inside the low population zone where they change to the "hot" train for the remainder of their journey to the site. Once at the site they are bussed to the plant and change into their work clothes. Vehicles are not allowed to cross the boundary of the low population zone (nominal 30 km). Personnel must get out and change vehicles. The roads around the site were being continually sprayed with water to keep airborne activity down.

After we completed our tour of the site we were taken to the abandoned town of Pripyat, which is about four kilometers from the site. Although no one lives in the town, a few people still work in the town. We were taken to one of those work areas, a horticultural research station, where the effect of radiation on plants and trees was being studied.

8. Recommendations

A. For GAEN

The administrative work load for the site chief inspector should be reduced or allowed to be substantially delegated.

With the completion of Unit 6, consideration should be given to assigning more operational safety inspectors to Zaporozhe.

GAEN should consider broadening its enforcement authority to allow it to take enforcement action against organizations, thus supplementing its current practice of taking enforcement actions only against individuals.

B. For NRC

The processes and equipment used to reduce the collective radiation exposure and radwaste releases at the Zaporozhe NPP should be studied by the NRC for possible application in the US.

Information on the effects of GAEN's policies regarding site inspector assignment length and previous employment at a licensee's facility should be studied by the NRC to better understand the balance between inspector objectivity concerns and the advantages associated with improved plant-specific inspector knowledge.

C. Recommendations for the Inspector Exchange Program

The inspector exchange program should be continued; however, the length of the visit should be shortened to a maximum of five weeks.

Since the greatest differences between the NRC and GAEN appear to occur at the regional and national levels, future Working Group I activities should focus there. In addition, Working Group I should also explore GAEN's interactions with design organizations.

Due to inherent logistical difficulties involved in traveling to foreign countries, the names of the individuals selected for the next exchange should be given to the other side by January 1 of each year. The host country should be requested to provide itineraries for the visiting inspectors by April 1 of each year.

APPENDIX D

TRANSLATED EXCERPTS OF PRESS INTERVIEWS GIVEN IN USSR

A. "Energiya" [the Zaporozhe NPP in-house newspaper] - "A Delegation of US Inspectors"

A delegation of inspectors from the US Nuclear Regulatory Commission is currently visiting the GAEN Inspection Office here at our plant. They arrived in our country in fulfillment of GAEN/USSR's obligations under an agreement with the NRC to exchange inspectors in order to learn about the organization and day-to-day work of inspectors at nuclear power plants.

The American specialists will spend five weeks at Zaporozhe.

Leonard Callan and Philip Brochman shared with us their initial impressions of our plant through their interpreter, Michael Launer.

"All the discussions we have already held with the plant director and with his colleagues have been very open," said L. Callan. "And that is very important because we can't accomplish anything without frank discussions."

P. Brochman seconded the opinion of his colleague. "The Soviet specialists have understood us completely, and we them. Inspectors of both countries have the same task--ensuring the safe operation of nuclear power plants."

"The inspector exchange," L. Callan added, "is only part of a large program of cooperation in the area of nuclear power production. Shortly before leaving for the USSR I participated in receiving a delegation from the I. V. Kurchatov Institute of Nuclear Energy at a nuclear power plant in the state of Texas."

P. Brochman concluded our brief conversation with these words: "In the course of these five weeks we [will] have familiarized ourselves with how GAEN carries out its responsibilities. Some things in your experience will be useful for us, and we will share [our experience] with you."

It is pleasing to note that our guests like the Ukraine and its mild climate. In just these few days they have come to appreciate the cordiality of the Soviet people and their sincere desire for cooperation.

Accompanied by Valentin Danilovich Stetsendo, Deputy Chief Administrator of the Southwest Region of GAEN/USSR, the American inspectors have visited Kiev and learned about the history of the Ukraine's capital.

The results of this visit to the Zaporozhe nuclear power plant by the American inspectors from the US Nuclear Regulatory Commission will be summed up [at a meeting] in the second half of August.

G. Blanutsa

B. "Zaporiz'ka Pradvda" [communist party regional newspaper] - "Americans at the Zaporozhe NPP"

A group of American nuclear power plant operational safety inspectors has spent nearly four weeks at the Zaporozhe NPP in connection with an agreement between GAEN/USSR and the American Nuclear Regulatory Commission. Our correspondent met with the American specialists and asked them to describe the purpose of their visit.

"Inspector exchanges," said Leonard Callan, "have become routine events for us. Last year we had French specialists visit our country; this year, Soviets; and next year we expect [a visit from] the Swedes. And now it is we who are visiting your country. We have come to the Zaporozhe nuclear power plant to learn firsthand about GAEN's organization and methods, to borrow what Soviet specialists do best, and to share our own experience."

- "What are your first impressions of what you've seen?"

"Our impressions have been pleasant. No one has hidden anything from us. Things have been completely open. And we like the [Soviet] specialists," said Philip Brochman. "I can even say this: There is more that your inspectors and ours have in common than there is separating them. They are principled, good people with a high level of professional competence. It is particularly pleasing that they understand the technological basis of the station; [this is so] because they are familiar with the technology from the first unit--its construction, installation, and pre-operational testing--right down to the sixth. This is particularly important; we don't have this in the States."

- "Can you tell us in detail what you will adopt [lit: take back home] from the energy workers at Zaporozhe and what negative features have you found [lit: what would you reject]?"

"We still have two more weeks of work," Leonard Callan answered. "Only then will we have the right to make overall generalizations. But I can say one thing for sure: both Soviet and American inspectors take their work seriously."

L. Kulagin

C. "Trud" [the national labor daily newspaper] - "Mini-interview: Inspectors from across the Ocean"

For about four weeks a group of inspectors from the Nuclear Regulatory Commission (USA), in accordance with an agreement with GAEN/USSR have been familiarizing themselves with matters pertaining to the safe operation the Zaporozhe nuclear power plant. A "Trud" correspondent met with members of the group.

- "How have you been treated at the power plant?"

"We have been in all areas and shops of each unit," said group leader L. Callan. "Our discussions with Soviet specialists and the plant management have been completely open. This is very important. After all, the task that stands before us is the same--guaranteeing the complete safety of work at nuclear power plants. By the way, the inspector exchange is just a small part of our collaborative effort in the area of nuclear power."

- "How, in your opinion, is GAEN carrying out its responsibilities?"

"We haven't come to any firm conclusions yet," inspector P. Brochman continued our conversation, "But it is already clear that [you have] fine specialists working at the plant who do their job conscientiously. I really like a sentence one of them said-±We are working so that Chernobyl will never happen again.' Undoubtedly, something from our experience will be useful to our Soviet colleagues, and we will borrow something from them."

Ahead lies a reciprocal visit.

A. Pavlishin
Zaporozhe oblast'

D. Moscow Domestic Service in Russian 1700 GMT 29 Aug 89

Subject: New AES Power Unit Comes On Line

The fifth generating unit of the Zaporozhe Nuclear Electric Power Station with a capacity of 1 million KW, has begun working on the country's unified energy system. Today, the deed of its acceptance for industrial operation was signed. This will allow a considerable reduction in the shortage of electrical power which exists in the Ukraine and other regions of the country.

From the inception of building the energy generating unit, everything has been subordinate to guaranteeing its reliable and safe work. The tuning of all the equipment has been carried out strictly in accordance with the safety regulations at an AES which are in force in the USSR. Installed on the energy generating unit are the latest systems to reliably guarantee its steady work. This was affirmed also by a group of inspectors of the US Nuclear Regulatory Commission, who worked here for over a month.

At the station there is constant monitoring of the state of the environment.

Received by
FBIS, London, UK

Note: No interviews were given for this article.