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New York Power Authority

J. Phillip Bayne
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September 7, 1984
JPN-84-59

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Shift Technical Advisor Qualifications
NUREG-0737 - Item I.A.1.1

References:

1. PASNY Letter, J.P. Bayne to T. A. Ippolito, dated July 31, 1981 (JPN-81-57).
2. NYPA Letter, J.P. Bayne to D.B. Vassallo, dated January 26, 1984 (JPN-84-05).
3. NRC Draft Policy Statement on Engineering Expertise on Shift (Federal Register Vol. 48, No. 143, July 25, 1983).

Dear Sir:

This letter provides a description of the FitzPatrick program for the eventual phase-out of the Shift Technical Advisor (STA) position. Reference 1 indicated that the STA position would be retained at FitzPatrick until criteria for the qualifications of operating shift personnel to fulfill the STA role were complete. In Reference 2 the NRC was informed that the Authority had initiated an Advanced Technical Training Program for Senior Reactor Operators (SROs) at FitzPatrick to provide engineering education and training that meets or exceeds the guidelines contained in Reference 3. This advanced training, for the first group of Shift Supervisors and Assistant Shift Supervisors (all holding current SRO licenses) is nearing completion.

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In addition, the Authority has recently received a summary of the Advisory Committee on Reactor Safeguards (ACRS) July 12, 1984 meeting, at which NRC personnel presented to the ACRS the "Final Policy Statement on Engineering Expertise on Shift" as approved by the Office of Nuclear Reactor Regulation (NRR). The Authority notes that the "final policy" is not significantly different than the "draft policy".

The Advanced Technical Training Program is being conducted by Memphis State University Center for Nuclear Studies which is accredited by the Southern Association of Colleges and Schools, and is being conducted on the FitzPatrick site. The teaching staff hold faculty or adjunct faculty rank in the Academic Department of Memphis State University. The program comprises thirteen (13) courses which are based on the STA job qualifications and responsibilities outlined in NUREG-0578. The thirteen courses include 540 contact hours of academic instruction for a total of fourty-one (41) credit hours. A description of courses, contact hours, and credit hours is shown in Attachment 1.

Upon completion of training for the first group of Shift Supervisors and Assistant Shift Supervisors in October 1984, personnel will return to their regular shift duties allowing another group to commence training in early 1985.

When a Shift Supervisor or Assistant Shift Supervisor that has completed the program is on shift, that individual will also assume STA responsibilities in a "dual-role" position in a manner similar to that described in the NRR presentation to the ACRS on July 12, 1984. Since initially not enough Shift Supervisors or Assistant Shift Supervisors will have completed the program to allow complete phase-out of the STA, some operating shifts will continue to be staffed with an STA in addition to two (2) SROs (Shift Supervisor and Assistant Shift Supervisor). All shifts are expected to have personnel that have completed the program by the fall of 1985.

The Authority considers the criteria for the qualification of Operating Shift Personnel to fulfill the duties and responsibilities of the STA in a dual-role position to be complete, and will consider those SRO's that have completed the Advanced Technical Training Program described in Attachment 1 as having met this criteria.

In addition, the Authority considers this approach to be in full compliance with the current FitzPatrick Facility Operating License and Technical Specifications. However, in the near future, the Authority will request an amendment to the Technical Specifications which will explicitly state that qualified Shift Supervisors and Assistant Shift Supervisors will assume STA responsibilities on shift.

The Authority indicated in Reference 1 that waivers for education, experience, or the establishment of degree equivalency would be evaluated on a case-by-case basis for STA candidates and that approval would be required by the Senior Vice President for Nuclear Generation. Since Reference 3 and the final policy presented to the ACRS clearly establish the requirements for alternatives to a BS Degree in Engineering for the dual-role Shift Supervisor/ STA or Assistant Shift Supervisor/STA, the Authority will not require Senior Vice President - Nuclear Generation approval for those non-degreed individuals that have successfully completed the Advanced Technical Training Program.

Should you or your staff have any questions concerning this matter, please contact Mr. J. A. Gray, Jr. of my staff.

Very truly yours,

J. P. Bayne
First Executive Vice President
Chief Operations Officer

CC: Office of the Resident Inspector
U.S. Nuclear Regulatory Commission
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NEW YORK POWER AUTHORITY
James A. FitzPatrick Nuclear Power Plant

Attachment 1 to JPN-84-59

The Advanced Technical Training Program comprises 13 courses which total 540 contact hours of instruction. The following synopsis identifies the subjects covered in each course.

SUBJECT AREA	CONTACT HOURS
Differential Calculus	50
Integral Calculus	50
Advanced Reactor Physics	40
Materials Study Course	40
Fracture Mechanics	40
Corrosion Chemistry	40
Computer Technology	40
Electric Generation and Transmission	40
Thermodynamics I	40
Thermodynamics II	40
Heat Transfer	40
Fluid Mechanics	40
Human Behavior	40
	540 hours*

*An additional 540 hours of faculty contact is available to students during on-site in-classroom self-study.

Differential Calculus: Designed to develop skill in problem solving which involves use of derivatives and functional notation, provide the mathematical basis for further technical studies, and develop confidence in solving current physical problems applicable to nuclear power plants and the industry. Topics include the following:

*Algebra including an extension of basic algebraic concepts and techniques of problem solving learned in mathematics course(s) of operator license programs to include the concepts and techniques important to calculus, vector algebra, and complex functions.

*Trigonometry including an extension of basic trigonometry learned in operator license training to include specific trigonometric relationships important to calculus including the fundamental identities, trigonometric formulas, and trigonometric laws.

*Geometry including the graphing and manipulation of specific algebraic functions, an analysis of their properties, and their relation to physical properties of materials and design of equipment.

*Special Functions including functional notation and manipulation, algebraic functions, algebraic series, transcendental functions, and the relation of algebraic series to physical problems.

*Differentiation including the concept and technique of differentiation, specific formulas, geometrical interpretations, and the application of differentiation to the solution of problems.

*Special Applications of differential calculus to problem solving in physical science and application to problems in nuclear power plants.

Integral Calculus: Designed to provide fundamental knowledge of the concepts and techniques of calculus and develop skill and proficiency in solving problems necessary to effective learning in advanced technical courses. Topics include the following:

*Integration including introduction to the concept of integration, integration formulas, geometric interpretations, and the application of the indefinite integral to problem solving.

*Definite Integrals including practice in solving definite integrals, geometrical interpretation, and the application of definite integrals in the solution to engineering and scientific problems.

*Multiple Integrals including techniques of solving multiple integrals, and their application to the solution of problems.

*Applications including an application of integral calculus to special problems in nuclear reactor engineering and design; thermodynamics; area integrals on xy, PV, and TS coordinate; Entropy as integral (dQ/T); special problems in heat transfer, fluid flow, and structural analysis.

*Differential Equations including introduction to ordinary and partial differential equations, their application to physical problems, and techniques of solution.

*Special Techniques including an introduction to Laplace transforms and Fourier analysis and their application to problem solving.

Advanced Reactor Physics: Designed to expand the student's knowledge of the basic physics of nuclear reactors by detailed development of concepts such as spatial dependence of neutron fluxes, neutron losses in the high energy range, effects of heterongeneous arrangements of reactor materials, temperature coefficients of reactivity, reactor poisons, core lifetime, kinetic behavior of neutron populations, and reactor power oscillations. Topics include the following:

*Neutron Diffusion including the analytical treatment of the diffusion equation, physical meaning, and measurement of parameter such as the diffusion length, neutron flux shapes in various reactor regions, leakage from the reactor, criticality conditions, and subcritical multiplication.

*Neutron Slowing-Down including the physics of kinetic energy loss by elastic collisions, the moderating properties of various materials, the concept of the Fermi Age and its meaning in terms of leakage losses of fast neutrons, absorption losses during slowing-down and the (absorption) resonance escape probability, the fast effect and the physical basis of the thermalization process.

*Kinetic Behavior of Reactors including an in-depth discussion of the effects of prompt and delayed neutrons, methods for calculation of the time-dependence of the neutron flux after a step change in reactivity, the "prompt jump", the stable reactor period, and reactor power oscillations.

*Special Topics including fission product poisoning, equilibrium concentrations of xenon and samarium for various neutron flux levels, "dead-time", fuel burn-up, poison burn-out, chemical shims and core lifetime.

*Multi-Region Reactor Theory including the calculation of all of the important parameters of reflected reactors by means of multi-group methods, heterogeneous fuel-moderator-coolant core arrays, neutron density in the vicinity of control rods and control rod worth.

*Temperature Effects on Criticality including calculations of the reactivity under various conditions, effects of changes of material densities on neutron leakage and resonance absorption, and Doppler effects on thermal neutron cross sections and on the resonance escape probability.

Materials Study Course: An introduction to terminology, fundamental properties and concepts; methods of fabrication and testing; the causes and prevention of failure in metals, ceramics, plastics, elastomers, lubricants, welding materials, and coatings used in nuclear power industry with special emphasis on failure case histories of materials in nuclear power plants. Topics include the following:

*Introduction and summary of course, identification of objective and the relation of objectives to generic failure case histories.

*Metallic Materials including the mechanical behavior of metals, families of ferrous and non-ferrous metals, carbon and low alloy steels for castings, low and medium alloy steels, stainless steels high-temperature high-strength alloys for castings, copper, aluminum, refractory metals, precious metals, environmental and service conditions, effect of environment on materials selected for use in the reactor pressure vessel and primary systems, service piping, codes and standards, and selected examples of metal failures.

*Plastics and Elastomers including an introduction to the molecular structure of plastics, physical properties and characteristics of plastics, applications of plastics and similar materials, the compatability of plastics with other materials and operating conditions, common causes of performance failure of plastics, codes and standards, and case histories of failures.

*Ceramics including an introduction to ceramic raw materials, fabrication of ceramics, physical properties, physical structure, ceramic equilibrium phase, structural imperfections, codes and standards, and case history of failures with emphasis on fuels.

*Special Materials including an introduction to basic properties and characteristics and failure modes of lubricants, hydraulic fluids, protective coatings, and welding materials used in nuclear power plants with emphasis upon case histories of failure.

Fracture Mechanics: Designed to familiarize the student with the fundamental concepts of fracture mechanics, representative case histories of failures, and develop skill in analyzing component designs for potential failures and failed materials to determine reasons for failure. Topics include the following:

*Crystal Structure including an introduction to crystal lattice structures, crystal defects, and microstructure with special application to metallic materials and ceramics.

*Mechanical Properties of Metals including fundamental concepts of stress and strain, stress-strain diagrams, elasticity, and safety factors with emphasis on metals used in reactor primary system components, and service piping.

*Thermal Properties of Metals including concepts of temperature expansion heat transfer, thermal stress, and creep with emphasis on temperature transients in power plants.

*Fracture Mechanics including a study of the fracture mechanism and fracture mode and an analysis of common failure cases in components.

*Methods of Testing including a review of materials testing program such as drop weight testing, Charpy V-notch impact tests, and Charpy transition curves.

*Neutron Damage including a study of the effect of neutron radiation on the properties of steels, such as nil-ductility temperature, failure case histories due to neutron irradiation, and design considerations in nuclear power plants.

Corrosion Chemistry: Designed to familiarize the student with the basic principles underlying corrosion of metals; the effect of corrosion; methods of prevention in design, use, and storage of materials; and failure case histories in generic power plants. Topics include the following:

*General Attack corrosion as introduction to classification of corrosion processes. Corrosion in power plants operating under high pressure, stress, and temperature conditions. Introduction to various specialized types of corrosion significant in causing component failures.

*Electrochemical Corrosion as based on chemical attack, but modified as an electrical phenomenon in which the metal atoms have an electr cal charge as ions. Action of ions with an electric potential to cause the chemical transformation of the material and galvanic theory.

*Stainless Steels replacing ordinary steels in meeting the corrosion resistances required in high-pressure high-temperature nuclear power plants. Stainless steels are more resistant to the usual corrosion processes but subject to their own particular difficulties, including stress corrosion cracking and passivity reduction under specific unusual conditions.

*Special Corrosion Processes including crevice corrosion, stagnant corrosion, pitting, leaching, caustic embrittlement, chloride stres corrosion, stress fatigue, blistering, intergranular corrosion, weld decay, temperature sensitivity, filiform corrosion, biological attack, etc.

*Erosion including the abrasive effect resulting from high flow rate and resulting in erosion, impingement, cavitation, fretting, etc.

*Nuclear Pressure Vessel and Tubing corrosion classified by type of equipment and frequency of occurrence. General corrosion in pressurized water reactors, stress corrosion cracking in boiling water reactors, denting in tube bundles, etc. Failure case histories, methods of prevention.

Computer Technology: Designed to develop familiarity with the basics of computer science including programming languages, hardware and software systems, and applied computer logic in order to develop skill in using computer programs to solve complex engineering problems applicable to nuclear power plants. Topics include the following:

*Program Languages including a review of FORTAN IV and BASIC with emphasis placed upon input/output, program logic, arrays, sub-programs, modeling techniques, complex arithmetic, and double precision operations.

*General Computer Technology including the theory of digital device and the design of basic logic circuits to solve problems encountered in the nuclear industry, number systems, digital arithmetic, Boolean algebra, and reduction techniques.

*Computer Systems including analog and digital computers, large scale computer systems, minicomputers, microcomputers, micro- processors, and time-share systems.

*Digital Systems including advanced digital circuit design, complex digital devices and computers, input/output devices, random-access storage devices, sequential logic, and advanced integrated circuit systems.

*Problem Solving including the solution of problems applicable to the nuclear industry by developing algorithms and utilizing "hands-on" experience in implementing programs for data assimilation and handling, instrument data interpretation, radiation transport, fluid flow, and heat transfer.

Electric Generation And Transmission: Designed to develop understanding of the principles of electric generation and transmission and the use of instrumentation in nuclear power plants. Topics include the following:

*Basic Electric Generation including a review of electric fields, current flow, Coulomb's law, potential, conductors, insulators, semi-conductors, resistance, resistivity, Ohm's law, Kirchoff's law, circuits, motors, and generators.

*Plant Generation including a review of generator arrangement, multiphase generators, generator rating, voltage, efficiency, rotor and stator construction, cooling systems, excitation systems and parallel operation.

*Station Electric Circuits including familiarization with bus arrangements, basic generator connections, control-power connections, switching equipment, circuit breakers, plant transformers, power-transforming rating, losses, efficiency, and instrument transformers.

*Electric Transmission including investigation of problems associated with the transmission of electrical energy, load-flow studies, and fault analysis including load variation, centralized control, power transmission, high tension lines, and transformers.

*Instrumentation including a study of principles of controlling plant system variables, insuring reliability, and providing for the automated control of nuclear power stations by understanding the basic operation of temperature instruments, flow transmitters, pressure measuring devices, level indicators, various electrical meters, and radiation monitors.

Thermodynamics I: The first course in thermodynamics covers basic concepts in energy flow and the mathematical aspects of its transformation. Thorough discussion of the exact nature of the different kinds of energy serve as a vital introduction to the general energy equation as applied to non-flow and steady-flow processes. Special thermodynamic properties such as enthalpy, entropy, etc. are introduced in order to understand the proper application of the "laws" of thermodynamics. Topics include the following:

*Dimensions, Units, and Properties including a review of the basic units of length, area, volume, mass, and force that underlie the units and concepts of pressure, temperature, heat, and work.

*Gas Laws including the relations between pressures, volumes, and temperatures for ideal gases leading to the properties of vapors such as steam.

*Non-Flow Process including a study of the non-flow energy equation inter-relating heat energy, pressure energy, work energy, and enthalpy.

*Flow Processes including flow processes which involve the general energy equation applied to steady-flow and non-steady flow processes. The various kinds of energy--potential energy, kinetic energy, internal energy, flow energy, etc. are examined.

*Introduction to Cycles as successive thermodynamics processes that form a closed loop or cycle that transforms heat energy into work energy. Work energy as transformed by a turbine into electrical energy. The concept of entropy as necessary in the application of the laws of thermodynamics for the understanding of the energy transformations.

*Carnot Cycle introduced as the most efficient cycle for determination of the available energy that can be transformed to energy output. Unavailable energy rejected from the plant as heat to the atmosphere or to cooling water.

Thermodynamics II: Application of the energy principles developed in the first course of thermodynamics to determine the performance of the components of equipment in the actual power plant. Topics include:

*Water and Steam including the basic properties of water and steam as a working medium of vital importance in understanding the thermodynamic energy transformations.

*Saturation Properties defining the pressure-temperature relationship that establishes the conditions determining whether the liquid water phase, the vapor steam phase, or two-phase conditions are present. An understanding of saturation conditions is important in avoiding TMI incidents.

*Reactor Power Plant Equipment including a study of the reactor as a source of heat energy, water heaters, steam generators, superheaters, turbines, and condensers.

*Basic Steam Turbine thermodynamics of the simple Rankine steam cycle involving boiler generation of steam and condenser cooling.

*Feedwater Heating involving the thermodynamics and economics of improving basic steam cycle performance by regenerative feedwater heating. Effect of steam superheating.

*Condenser Thermodynamics involved in condensing steam through heat rejection to river and seawater and to the atmosphere by cooling towers. Atmosphere cooling tower psychometrics are also studied.

Heat Transfer: A study of heat transfer in terms of conduction, convection, and radiation. Actual heat transfer as a combination of two or more of these modes. Fluid flow and overall heat transfer. Topics include the following:

*Basic Quantities including a review of notation, units, definitions, conversion, heat and temperature effects, physical properties, viscosity effects, and fluid flow effects.

*Conduction examined in terms of electrical analogy: heat flow, temperature decrease as potential, thermal resistance, and thermal conductivity.

*Convection including natural laminar stream-line, forced turbulent correlation by Reynolds, Nusselt, and other dimensionless number parameters.

*Radiation including a study of the Stefan-Boltzman law, emissivity absorptivity, reflectivity, transmissivity, angle factors, area cosine law, black and gray bodies, parallel planes, and other configurations.

*Overall Heat Transfer including thermal resistances of all kinds, thermal resistance in series and in parallel, cavities, shapes, materials, log mean temperature difference (LMTD), and heat exchangers.

*Boiling Two-Phase Heat Transfer including a study of boiling phenomena, saturation, pressure-temperature relationships, pressure to prevent boiling, burn-out, and other high-heat-flux phenomena.

*Condensation considered as boiling in a reverse direction. Modification of pressure-temperature relations due to less sensitive operation than the high pressure-temperature relationships of boiling.

*Application to heat transfer from reactor fuel pins to coolant including the properties, characteristics of fuel and fuel claddin and the effects of heat transfer.

*Application to heat transfer in steam generators of pressurized water reactors.

Fluid Mechanics: Study of fluid flow as a function of pressure differentials. Single phase flows, two phase flows involving liquids and vapors. Fluid mechanics and fluid dynamics governed by thermodynamic energy relationships and thermal properties. Secondary effect resulting from inclusion of heat flow. Topics include the following:

*Fluid Flow Basic Principles including measurements units. Properties of pressure, density, and specific volume. Continuity equation. General energy equation.

*Ideal Fluid Flow without friction. Basic analysis simplification considering friction as absent or minimal. Static dynamic and total pressure. Bernoulli equation. Hydrostatic jet equation. Bernoulli head equation.

*Actual Fluid Flow friction effects superimposed on the flow of ideal fluids. Friction resulting in heating and the necessity for examining fluid properties. Viscosity, Reynolds number, head equations with system losses. Fluid hammer.

*Fluid Flow Measurement based on pressure drop, volume flow as a function of pressure drop and pressure drop as a measure of flow quantities. Venturis, flow nozzles, and orifice meters. Flow measurement by other than pressure drop.

*Fluid Flow Pumps including ideal input to pump, pump efficiency, pump cavitation, types of pumps, pump laws, pump operating point, and pumps in parallel.

*Fluid Flow In Turbines based on applications of the second law of thermodynamics. Single and multistage turbines. Nozzles. Mollier diagram. Convergent and convergent-divergent nozzles. Ejectors.

Human Behavior: A study of the basic principles of psychology necessary to understand and assess personality traits and how individuals perform on teams and under emergency conditions. Topics include the following:

*Basic Principles of psychology in study areas such as personality, abnormal behavior, intelligence, learning, sensation, and perception including terminology used in professional communication.

*Personality Traits including a study of concepts and principles in normal and abnormal behavior which will develop an understanding of patterns of intellectual and behavioral development in individuals; allow recognition and logical assessment of deviations from normal behavior,

neurotic and psychotic reactions; develop an understanding of organic, genetic, and environmental influences on personality; and provide a method of identifying specific personality traits and predicting behavior under specific circumstances.

*Social Traits as a study of the behavior of individuals in group settings including cooperation, leadership, inter-group and intra-group relations which will develop skill in recognizing leadership and identifying individuals who cannot work cooperatively with teams.

*Applied Psychology in the industrial setting with emphasis on methods of selecting personnel, aptitudes, classification and evaluation of personnel, understanding and interpretation of employee attitudes, morale and motivation, understanding influence of work conditions and environments, and an introduction to methods of testing and screening of job applicants.

*Applications including an analysis of the impact of personal and social traits upon individual and group performance in selected accidents which will develop skill in assessing potential personal failures under conditions of stress.

Academic Credit is awarded as follows to students who successfully complete courses of the Advanced Technical Training Program.

Course Number	Course Title	Semester Credit Hour
MATH 1321	Analytical Geometry & Calculus	4 hours
MATH 2321	Analytical Geometry & Calculus	4 hours
TECH 3413	Materials Structure and Properties	3 hours
CHEM 3010	Corrosion Chemistry	3 hours
PHYS 3703	Stress Mechanics	3 hours
PHYS 4510	Thermodynamics	3 hours
CHEM 3031	Chemical Thermodynamics	3 hours
PHYS 3702	Nuclear Heat Mechanics	3 hours
PHYS 3701	Physics of Fluids	3 hours
ELEC 4202	Electrical Power Systems	3 hours
PHYS 4221	Advanced Reactor Physics	3 hours
TECH 3262	Computer Applications in Nuclear Power	3 hours
PSYC 3599	Special Topics in Applied Psychology	3 hours
		41 Credit Hours

In addition to the 41 credit hours for the 13 courses listed above, two (2) project courses of 3 credit hours each are to be completed. For these projects each student will select a specific component or system of a nuclear power plant and perform an analysis. The projects planned for this component of the program are intended to develop competence and experience in the analysis of systems, the assessment of operating experience, and in accident response. The student will learn to apply existing methodology for accident analysis to the particular case chosen for the project and document the results of his study in a report which he must defend in peer level as well as academic reviews.

*Technical Report Writing Instruction will be given to students enrolled in the project courses on technical report writing. This instruction will provide the student with the basic information needed to professionally prepare technical reports.

*Analysis Techniques Techniques will be provided to students enrolled in the project courses. These techniques will include methodology of analyzing systems, components, and technical reports.

*Projects Two projects are planned for this component of the program, each of which will serve as a separate 3 credit hour course.

*Reports A written report thoroughly documenting the study performed in each project and its results is required. Successful completion of the course is largely based upon the report.

*Faculty The projects are administered by members of the University faculty. Participation of plant management in project reviews will be solicited.