GNS '840614 051

TENNESSEE VALLEY AUTHORITY

NUCLEAR SAFETY REVIEW STAFF

EMPLOYEE CONCERN INVESTIGATION

NSRS REPORT NO. I-84-10-NPS

SUBJECT: ALLEGATION OF COLORBLINDNESS OF NUCLEAR PLANT EMPLOYEES

DATES OF INVESTIGATION: APRIL 10 - MAY 11, 1984

TEAM LEADER: Richard D. Smith
R. D. SMITH — DATE 6/13/84

APPROVED BY: M. A. Harrison
M. A. HARRISON — DATE 6/13/84

MEDS, W3B03 C-K

NSRS FILE

TABLE OF CONTENTS

I. SCOPE

An anonymous employee concern was received by the Nuclear Safety Review Staff (NSRS) alleging the possiblity of some colorblind personnel operating TVA's nuclear power plants. One person was assigned to the investigation and instructed to determine the validity and possible extent of the allegation and to prepare a report of the findings.

II. SUMMARY

NSRS received an anonymous employee concern on April 10, 1984. The alleger stated that some personnel with color deficiencies were being allowed to wear a red (x-chrom) lens in order to pass the TVA medical color examination for entrance into the Student Generating Plant Operation Program (SGPO), and there were people in the nuclear power program who were colorblind. The alleger further stated that an optometrist in Chattanooga was supplying the red lens to TVA employees. Early in the investigation it was learned that an EEO complaint had been filed on the same subject.

Throughout the NSRS investigation the Division of Medical Services (MED SV) and Office of Nuclear Power (NUC PR) were very helpful in providing information. The Nuclear Regulatory Commission (NRC) has specific medical requirements, including color vision, for licensed reactor operators. TVA had developed a standard and testing procedure for the color vision requirements and applied the standard and testing procedure also to nonlicensed positions which were considered in the career development path for a licensed reactor operator. MED SV personnel stated that x-chrom lenses had been allowed in the past and approximately 3 to 12 candidates for SGPO training had used them. An x-chrom lens, a red contact lens, worn in only one eye, changes the intensity of red and green colored light seen by the lens-covered eye as compared to the unaided eye. The brain learns to interpret the intensity difference as a color. In 1982 MED SV prohibited the use of any contact lenses for people who have occasion to wear a full-face respirator. That action was consistent with regulatory and standard setting bodies requirements on the same subject. Therefore, x-chrom lenses were prohibited. MED SV, however, never officially approved or disapproved the x-chrom lens based upon its merits and their procedures and guides contained no reference to x-chrom lenses. Their approved use was apparently a decision based upon professional judgment by the examing physicians.

MEDS SV reviewed over 650 medical records of NUC PR personnel in the affected job classifications and found 3 individuals that had been or were wearing an x-chrom lens. Those individuals had been approved in 1981 before contact lens were disapproved, and two of the three no longer required the use of the x-chrom lens. Standard MED SV procedures used to notify supervisors of an individual's medical constraints, form TVA 1444 (lifting restrictions, prescription glasses, etc.), was used only twice. Form TVA 1444 for the individual still wearing an x-chrom lens did not identify that medical constraint. It was also determined that the three had not obtained their x-chrom lenses from the same source.

Further review of the 650 plus medical records by MED SV showed that no one had a strong color deficiency and 8 employees were identified, in addition to the 3 x-chrom lens users, with color vision test results suggesting further examination was justified. An NSRS review of those records and further discussions with MED SV personnel at the nuclear plantsites revealed a deficiency in procedures and lack of rigor in handling indicated color deficiencies (wrong test given, incorrect follow-up test, incorrect test listed for the job, questionable information reported to NRC).

The color tests given by TVA (Orthorator and AO-HRR), which have been long accepted by the medical profession, were reviewed by NSRS. It was concluded that the screening test, the Orthorator, while very good at detecting color deficiencies, can be circumvented if the examinee can remember four of six numbers. The AO-HRR consisting of 20 different pseudoisochromatic colorplates would be extremely difficult to circumvent. In addition to the requirements for formal tests, the NRC regulations allow the use of a practical color examination, but TVA did not have one prescribed.

Based upon this investigation and MED SV's own review of their records, both MED SV and NUC PR have informally agreed to recommend to NUC PR upper management that a practical color test be developed. All NRC-licensed personnel would then be given a special color test. There was no evidence to indicate that TVA has any colorblind licensed operators, but this special test was considered necessary to remove any doubt about the licensed operators having adequate color vision. They were to further recommend that career development nonlicensed positions be given the same test but during their regularly scheduled periodic physical examination. NSRS concurs with these actions. In addition, MED SV needs to evaluate their program regarding color testing and the review of results, make necessary changes, and communicate those changes to personnel involved in the testing/ review process.

III. FACTS

A. Allegation

On April 10, 1984, an anonymous telephone call was received by NSRS regarding color vision deficiencies among nuclear plant operators and assistant unit operators. The alleger stated that some personnel having color deficiencies were being allowed to wear a red contact lens in order to pass the TVA medical examination and that there were people in the nuclear power program who were colorblind. The alleger further stated that an optometrist in Chattanooga was supplying the red lens to TVA employees.

Discussions with NUC PR and Office of the General Counsel (OGC) personnel revealed that an Equal Opportunity Compliance (EOC) complaint had been filed on the same subject

The person that filed the EEO complaint is not the same individual that raised the employee concern. Only the subject matter is the same. Personnel within EOC provided information

and documentation regarding the complaint which alleged that two "guys" (names unknown) were in Chattanooga, at the same time as the EEO complainant to take the medical examination for admittance to the SGPO program (reference 1). The allegation continued that the two "guys" were from Bellefonte, one had a red contact lens flown in from Nashville and "both of them used the red contact lens." The EEO complainant in an affidavit, supplied the names of two assistant unit operators (AUO) with red-green color deficiencies, one of which allegedly had a red contact lens obtained from an optometrist in Chattanooga. Regarding licensed operators with color deficiencies, the EEO complainant did not know of any.

In an interview with the EEO complainant he stated that he could not wear a red lens because he did not have fusion between both eyes and his optometrist said it would not be beneficial. The EEO complainant further stated he believed his color vision was adequate and wanted admittance to the SGPO program on that basis.

B. Background

1. Color Vision Test and Criteria Development

The NRC requires in 10CFR55.11 that the physical condition, including vision, of an applicant for a reactor operator license shall be such that it will not contribute to operational errors. This requirement is further clarified in Regulatory Guide (RG) 1.134, "Medical Evaluation of Nuclear Power Plant Personnel Requiring Operator Licenses," which states that NRC would be satisfied with methods used to implement ANSI N546-1976, "Medical Certification and Monitoring of Personnel Requiring Operator Licenses for Nuclear Power Plants." With no exceptions, TVA adopted ANSI N546-1976 and its revision ANSI/ANS-3.4-1983. The ANSI standard requires, in part, "color vision adequate to distinguish among red, green, and orange-yellow signal lamps, and any other coding required for safe operation of the particular facility as defined by the facility operator." The standard further specifies that nuclear reactor operators shall be examined biennially by a licensed medical practitioner conversant with the standard and with a general understanding of activities required of the operator. Should an examinee fail to meet any of the minimum requirements but can demonstrate complete capacity to perform operational duties to the satisfaction of the facility operator (authorized representative of the production license holder), the facility operator may recommend the medical examiner waive that requirement.

Ultimate approval of an applicant for an operator's license resides with the NRC and is based, in part, on medical information supplied on NRC Form 396, "Certificate of Medical History."

2. Medical Services Criteria

Within TVA, responsibility for determining the medical adequacy of operations personnel in meeting the requirements is assigned to MED SV. MED SV has two documents which describe the medical requirement and administrative procedures used for TVA employees. One is the Medical Services Examiner's Guide which defines the administrative procedures regarding the examination approval and/or disapproval, for medical reasons, of an individual's ability to perform the functions of his/her job. It includes, by reference and in total, ANSI/ANS 3.4-1983, and describes the process for sending, to NRC on NRC Form 396 the results of the medical evaluation of applicants for a facility operator's or senior operator's license. The Examiner's Guide specifies that "The TVA physician's determination of the applicant's medical qualifications and medical disposition, including any medical constraints, are entered on the (TVA form) 1444." That form, and the original copy of the NRC Form 396 in a sealed envelope labeled "Administratively Confidential," are sent to the plant superintendent. The NRC Form 396, along with other licensing documentation, is sent by the plant to NRC.

The other MED SV document describing medical requirements and procedures is the "Job Title Code Guide." That guide lists the official TVA job titles and their associated special medical examination codes to comply with legislative, regulatory, or other requirements. It also includes vision profile requirements and potential exposures, i.e., chemical, dust, radiation, associated with the job. A detailed description of vision requirements and associated medical procedures is contained within that document which had been maintained current over the years. In total, there are 12 different vision profiles (requirements) for TVA employement positions one of which, Profile 5A, applied to nuclear plant operators and positions allowing a career development path to nuclear plant operator.

3. Vision Profile

The vision profile of nuclear operators has evolved over the years as needs and requirements changed. For a complete understanding of the current 5A profile, as it pertains to color vision, an historical description of its development is provided below.

The earliest obtainable copy of the job title code book was dated July 1971. At that point in time a vision profile 5 was required for auxiliary operators (AOs) selected for training, SGPOs, assistant unit operators (AUOs) and unit operators and was applied to personnel in nuclear, hydro, and fossil plants. Complete vision profiles have been given since 1947 on a machine called an Orthorator. Color vision

was evaluated by an examinee's ability to distinguish a colored number written on a multi-colored background of slightly different hues of the same color as the number. This test contained six different numbers, which have not changed since 1947. For a vision profile 5 a passing score would be the ability to distinguish at least four of those six numbers.

On April 12, 1976, the American National Standards Institute, Inc., approved the medical standard for nuclear plant licensed operators ANSI N546-1976 which was subsequently adopted by TVA. In a memorandum dated February 24, 1977 from J. R. Calhoun, Chief, Nuclear Generation Branch, to R. L. Craig, Director of MED SV, the color vision requirements were identified for NRC operator licensees and potential NRC operator licensees. Those requirements resulted in the development of a new vision profile 5A, the requirements of which were transmitted by memorandum dated March 14, 1977, from R. L. Craig to TVA Medical Examiners. Both the vision profile 5 and 5A required a score on the Orthorator of four or more to pass. If an examinee scored less than four, additional testing would be performed. For the vision profile 5, that additional testing consisted of being able to distinguish between red, yellow, and green lights using the Orthorator. The profile 5A required further testing, not on the Orthorator, but using AO-HRR pseudoisochromatic plates. The AO-HRR test is similar to the Orthorator test, but instead of identifying numbers, the examinee identifies various colored shapes on a background of multicolored spots of different hues of the color shape being identified. There are 20 different plates, and depending upon the ones identified, a rating of mild, medium, or strong color deficiency can be identified. A mild red-green color deficiency has been acceptable to TVA and the NRC.

Also contained in the March 14, 1977 memorandum was the requirement that all nuclear operators, operator transferees to nuclear plants, and all applicants for SGPO program training meet the 5A profile. It should be noted that there are no NRC color vision requirements other than for the licensed operators (SRO and RO) and licensed shift engineers (SE and ASE), and the 5A profile requirement for other operator positions at the nuclear plant is TVA's requirement. Recognizing the possibility that some personnel already licensed or in the SGPO program may not pass the more stringent requirements, a provision was made for a special color ability assessment.

In June 1981, the job title code book was revised to show, among other things, the vision profile change adopted in 1977. The vision profile 5A was assigned to NRC licensed positions and SGPOs. However, the AUO (to which a successful graduate of SGPO training progresses) remained a profile 5. The job title code book, again revised in October 1983,

contained the same less stringent vision profile 5 requirement for AUOs but changed the vision profile for the AO from a 5 to the more stringent 5A. The normal career development path is from AO to SGPO to AUO and then to licensed operator.

4. X-Chrom Lens

In about 1971, the x-chrom lens was invented to improve color discrimination. The x-chrom lens was named after the female chromosome on which the recessive gene for color-blindness is carried. The x-chrom lens is a hard contact lens having a cranberry red color. Only one lens is worn over the nondominant eye to improve color discrimination. The x-chrom lens does not correct a color deficiency; rather, it enhances the contrast or light intensity between red and green. The unaided eye seeing the colors confused yields to the x-chrom aided eye and the brain learns to identify a color with different intensitites of light.

Reviewing some published literature on the subject revealed differences in the long-term (greater than a day) benefits from an x-chrom lens (references 2 and 3). In an interview with Optometrist, who has experience with these lens he indicated that the prolonged benefit of these lenses depended upon the degree of color deficiency. Color deficiencies that are relatively mild will have a longer lasting benefit from the lens than those that are more severe.
stated he had not supplied TVA people with x-chrom lenses.

At some unknown point in time, TVA was faced with the question of whether or not color deficiencies compensated for with an x-chrom lens would be acceptable. No official position was developed by MED SV on the x-chrom lens with respect to its color compensation ability, and MED SV examining physicians allowed and recommended their use. Ultimately the use of x-chrom lenses was prohibited, not specifically by name, but because they were contact lenses. Contact lenses were prohibited in a July 30, 1982 revision to the Medical Services Examiner's Guide for personnel requiring medical approval to wear full-face respiratory protection. The use of contact lenses by persons who must wear a respirator equipped with a full-face piece, helmet, hood, or suit had been prohibited by regulatory and standard-setting organizations for years. As TVA medical requirements for nuclear plant operators also include medical approval to wear a full-face respirator, contact lenses had been prohibited.

In an memorandum from R. L. Craig, Medical Director, to M. S. Jimerson, EOC counselor, the first documented position on x-chrom lenses was presented "...a red contact lens for one eye is not considered an acceptable

corrective device for SGPO applicants." That memorandum was prepared in response to questions raised by EOC that resulted from a pre-complaint conference on with the EEO complainant.

C. Review of Medical Services Practices Regarding Color Vision

Based upon the issues raised by the employee concern and the EEO complaint, NSRS conducted interviews with NUC PR and MED SV personnel to determine the validity of the issues. As a result of the EEO complaint filed on and a subsequent memorandum dated March 9, 1984 from the Director of Equal Opportunity Compliance to the Manager of Power, both NUC PR and MED SV were evaluating the issues.

NUC PR provided NSRS a list of BLN SGPO candidates for class that had physical examinations at the same time as the EEO complainant. A review of the form TVA 1444 for each identified SGPO candidate did not show any medical restrictions regarding color deficiencies or references to x-chrom lens.

A discussion with the EEO complainant produced information somewhat different than in his EEO complaint. The EEO complainant stated he did not know of anyone who wore an x-chrom lens or any colorblind licensed operators but held fast to the two "guys" from BLN who had used x-chrom lenses in their medical test. He could not recall their names, but he stated they were approved for the SGPO program. He stated they were approved because someone (caller unknown) from BLN called him at WBN and told him everyone tested from BLN had been approved for the SGPO program. NSRS could not find from an examination of medical records anyone in SGPO class who wore an x-chrom lens when taking their color examination.

Discussions with MED SV personnel revealed they had reviewed the medical records of two AUOs specifically named in the EEO complainant's allegation as having color deficiencies, one with an x-chrom lens. The records were shown to NSRS and both were described as having a mild color deficiency. Neither record had any reference to x-chrom lenses.

The AUO identified by name in the EEO complaint as having an x-chrom lens was contacted by NSRS. He stated he did not now nor had he ever worn an x-chrom lens. He said he was aware of their existance through his association with and said he had passed that information to the EEO complainant.

As a result of the EEO complaint and NSRS interest in color vision requirements MED SV was in the process of developing a list of personnel within NUC PR who had job descriptions requiring the vision profile 5A. Once the list was developed, a review of each medical record was planned along with the completion of a

form with pertinent color test information on each individual. The anomaly of the less stringent vision profile 5 for AUOs was presented by NSRS, and MED SV indiciated that anomaly and another for the job title assistant shift engineer-M (ASE), also requiring profile 5, had been identified by MED SV and both jobs were included in their planned survey. During the course of the NSRS investigation, MEDS SV reviewed approximately 650 records in their survey and identified 11 individuals with information suggesting further color deficiency evaluation was warranted. In an April 30, 1984 memorandum from the Director of MED SV to the MED SV Files, with copies to NUC PR and NSRS, the following categories and associated individuals were identified for follow-up testing:

1. Three licensed ASEs with medium red and green defects, but with demonstrated adequate color vision through on-the-job evaluation.

2. Three nonlicensed AUO and SGPO personnel identified as having used x-chrom lens.

3. Five nonlicensed AUO and SGPO personnel either having color defects greater than TVA's standard or insufficient testing results to confirm adequate color vision.

The survey did not identify anyone with a strong color deficiency. NSRS reviewed 10 of the medical records of the MED SV-identified individuals, and the findings of that review and discussions with MED SV personnel are contained in the next 3 sections.

1. Licensed ASEs

All three entered the SGPO program prior to the change, in 1977, to the more stringent vision profile 5A.

In 1977, Employee A , according to the TVA-administered AO-HRR test, indiciated a strong color deficiency. Further testing by a consulted opthalmologist concluded he had a mild color deficiency and he performed well on the TVA "yarn test" for colorblindness. The "yarn test" was a medically accepted colorblindness test. The NRC Form 396 sent to the NRC in 1977 stated that Employee A had a mild R-G color defect.

In 1979, Employee A was retested by TVA using the AO-HRR and again showed a strong color defect. However, with no further color testing, the NRC Form 396 was submitted to NRC indicating a mild defect. In subsequent color testing in 1980, 1981, and 1982, using both the Orthorator and AO-HRR tests, TVA documented a medium color deficiency and so reported it on the NRC Form 396.

In 1977, Employee B was rated by TVA as having a medium color deficiency. Additional testing by a consultant opthalmologist and the "yarn test" indicated a mild defect and was reported as such to the NRC on NRC Form 396. Subsequent evaluations using the Orthorator and AO-HRR tests in 1979, 1981, and 1983 continue to show a medium defect and the NRC Forms 396 have identified the medium deficiency and notes Employee B's demonstrated ability to perform duties which reflected the 1977 testing results.

In 1978, Employee C was rated as having a medium color deficiency. The NRC Form 396 showed a mild defect with the note "demonstrated adequate vision on the job." Employee C's medical records showed no documentation to support that note, and Employee C stated he had never been given a practical color vision test (yarn or control room walk-through). He further stated he had no problem identifying colors on the job. Employee C has been evaluated twice for color vision--once in 1981 as an ASE using the vision profile 5 instead of 5A and once in 1983 using vision profile 5A. In both the 1981 and 1983 exams, the Orthorator score for color indicated further evaluation was required, but the incorrect follow-up test for his job was given (the red-yellow-green lights versus the AO-HRR). The associated NRC Forms 396 were sent to the NRC specifying normal or adequate color vision.

2. X-Chrom Lens Users

The use of the x-chrom lens within TVA's nuclear power program presented some interesting observations. No one within MED SV could remember when or how the x-chrom lens came on the scene at TVA, but they remembered that some people had been approved for the SGPO program using them. Estimates on the number of users ranged from 3 to 12 with the best guess at about 6. None of the physicians or nurses could recall ever seeing one of these lenses. At the time x-chrom lens use was allowed, there were no restrictions on their use either as a contact lens or for compensating a color deficiency. In the three cases of x-chrom lens users found, one purchased his in the Huntsville area, another in the Chattanooga area, and it is unknown where the third purchased his. Each purchased them at their own expense, and based upon a Chattanooga MED SV examining physician's recommendation that they consider getting an x-chrom lens. The MED SV recommendation did not include where to get the lens. MED SV at the time of this investigation had not made an official decision on the lens based upon its own merits, but had disapproved them because they were a contact lens and contact lens were disapproved. Professional published literature on the subject had been obtained by MEDS SV and their general judgment was they were inappropriate for the jobs requiring color vision within NUC PR, but since they had

been excluded through association with contact lens in general, no decision specific to x-chrom lenses was made. According to MEDS SV, the x-chrom lens must be a contact lens; a standard pair of glasses with one red lens will not work. Not having an official position on the x-chrom lens, and therefore, not included in MEDS SV procedures, discussions with MEDS SV physicians revealed two different approaches when approving someone with an x-chrom lens. All agreed a notation would be made on the form TVA 9080, Medical Examination Record, but some said they would place a medical constraint on the individual and one said a medical constraint would not be assigned. A medical constraint on form TVA 1444 is the offical mechanism whereby a person's supervisor is notified of any medical problems the supervisor should be aware of.

Employee D was approved for the SGPO program in 1981 using an x-chrom lens. His forms TVA 9080 and 1444 showed the lens requirement and his supervisor was aware of the requirement. Discussions with Employee D indicated he always wore his lens when it was required, but he had had eye surgery (radial keratatomy) which apparently eliminated his need for an x-chrom lens. According to Employee D his vision was formerly such that he could not see the muted numbers well enough, but since his surgery he could. A 1983 examination showed an acceptable color vision without an x-chrom lens and his medical constraint was lifted by MED SV.

Employee E passed the 5A profile for AO in 1981 after obtaining an x-chrom lens. As in the case of Employee D all of Employee E's medical records reflected x-chrom lens use and his supervisor at BLN was aware of his medical constraint. Employee E also had a radial keratotomy and was able to pass the TVA AO-HRR exam showing only a mild R-G deficiency in 1983 and approved for SGPO training in class This is the same class that the EEO complainant tried to enter. Employee E's medical record shows his medical contraints had been removed.

Employee F was approved for SGPO training in 1981 using an x-chrom lens. His medical records showed the use of the lens, but his form TVA 1444 did not. In subsequent examinations in 1982 and 1983, his medical records showed he passed the Orthorator examination for color and no notation regarding x-chrom lens use was documented. In a discussion with Employee F he stated when he entered SGPO training he was told at the POTC he did not have to wear his lens during the training and he did not. During the two color examinations in 1982 and 1983, he stated he had not worn his lens and could not see the numbers without his lens but could see the red, yellow, and green lights. He said the passing scores recorded for him could not be his. The medical record for Employee F did not

have a score or indicate he took the red-yellow-green test as he said he had. The nurse practitioner at SQN where the test was given could offer no explanation for the apparent discrepancy.

3. Insufficient Testing or Color Deficiency Greater Than Allowed

Medical records for four of the five individuals in this category were reviewed by NSRS.

Employee G passed his vision profile 5A for admittance to the SGPO program in 1981. On two subsequent examinations in 1981 and 1983 at SQN he scored less than four on the Orthorator requiring the AO-HRR test. However, he was given the red-yellow-green light test instead. SQN did not have the AO-HRR plates and would have had to send Employee G to Chattanooga for the test.

Employee H was admitted to the SGPO program in 1978. He scored a one on the Orthorator and was given the required AO-HRR test but his record did not have a rating (mild, medium, severe) for his color deficiency. He was examined again in 1980, as an for a vision profile 5A and with an Orthorator score of one was only given the red-yellow-green light test. In a 1982 test, again as an , he was tested under vision profile 5, no Orthorator score was recorded and he was given the red-yellow-green light test.

Employee I was tested and accepted in the SGPO training program in 1981. Since that time, he was examined in 1982, 1983, and 1984 and his exams were incomplete with regard to color.

Employee J , was admitted to the SGPO program in 1975 and had an acceptable Orthorator score of 4, was given an AO-HRR test (though it was not required) but it was not rated. He was subsequently examined in 1978 and 1983, each time as an in 1983 he was actually an and the incorrect vision profile 5 was used. In both subsequent examinations, his Orthorator scores showed progressively fewer numbers seen. His 1983 exam included the AO-HRR test which was rated a medium deficiency (greater than allowed). His 1978 examination was performed by the mobile health lab showing an Orthorator score of two and an inability to detect all nine lights in the red-yellow-green light test. His form TVA 9080 showed unacceptable color and an indication that a letter was sent (receiver unknown, no copy in medical record). There was no form TVA 1444 prepared which should have alerted his supervisor of the problem. The medical records did not contain, for any test, any indications of a suspected problem or a need for corrective action.

D. Nuclear Plant Medical Offices

In discussing the test results described in section III.C.1, .2, and .3 above with the associated plant medical office personnel, inconsistencies were revealed with regard to the intent of medical approval for NUC PR positions. In all cases the test results were described as being reviewed clinically (the medical significance to the individual) rather than from a requirements standpoint (do the individuals meet the regulatory and TVA medical requirements for the job). If an individual were asked (e.g., about a color deficiency) if it affected his job performance and the answer was no, the deficiency would not be pursued further.

There was confusion expressed by some nurse practitioners about the 5/5A vision profile scoring plate. As described in section III.B.3 above, additional testing is required if an examinee scores less than four on the Orthorator pseudoisochromatic plates. MED SV has clear plastic scoring templates for all 12 vision profiles, that are placed over the visual performance profile portion of form TVA 9082, "Clinical Laboratory Examination Record." For any given vision profile, the scoring template is clear in the region of acceptable scores, dotted in a discretionary area of scores, and unacceptable in a lined area of scores. The vision profiles 5 and 5A use the same scoring template and has no discretionary area. The scores are either acceptable or unacceptable. On the 5/5A scoring template is the following instruction for additional testing:

or { RGY 5
   { AO-HRR 5A

The interpretation of the scoring template means, for color, the examinees Orthorator score must lie within the clear region (scores 4, 5, or 6) or the examinee must pass the Orthorator red-yellow-green light test for profile 5 (RGY 5) or the AO-HRR for the profile 5A (AO-HRR 5A). The confusion expressed over this scoring plate was that the word "or" before the braces indicated that either the red-yellow-green light test or the AO-HRR were acceptable for either vision profile. Additionally, with the exception of BFN, which first identified this confusion, none of the plant medical offices had AO-HRR plates or the training to administer them.

Several nurse practitioners indicated that until the current concern regarding color vision, they did not know what an x-chrom lens was.

E. MEDS SV and NUC PR Recommended Corrective Actions

Throughout this investigation information developed by NSRS, MED SV, and NUC PR was freely and frequently exchanged. Based upon this information and NSRS's verbal recommendations, NUC PR personnel working on this problem reported informally to NSRS the actions to be recommended to NUC PR management, These intended actions are summarized as follows:

(1) MED SV will officially prohibit x-chrom lens use.

(2) A practical color vision test will be developed within a month to six weeks by MED SV and NUC PR for those personnel currently licensed and in career development programs leading to licensed positions.

(3) Rigid color vision tests for incoming SGPO students will remain unchanged and not include a practical test.

(4) Color vision tests for personnel within positions designated as career development for licensed operators and licensed operators will consist of the current tests and, if necessary, a practical test.

(5) All licensed personnel and others with identified testing or color vision anomilies will have their color vision retested as soon as the practical test is developed.

(6) All personnel in career development positions will be retested during their regularly scheduled physical examination.

(7) MEDS SV will reemphasize their examination of color vision with regard to the established requirements.

IV. ANALYSIS

A. X-Chrom Lens

The x-chrom lens was invented in 1971 to improve color discrimination. There is no record of an x-chrom lens being used to correct a color deficiency of an operator in the nuclear program until 1981. During 1981 medical records show that three non-licensed employees used x-chrom lens to correct color deficiencies which enabled them to pass the TVA color vision tests. At the time these three employees were allowed the use of an x-chrom lens to correct a color deficiency there was no policy or guidance established within TVA regarding use of the x-chrom lens to correct a color deficiency. Prior to acceptance of the lens as a valid corrective device there is no indication in the records to indicate that there was a formal evaluation made by MED SV of the acceptability of the lens for meeting medical requirements. It appears the decision to allow the use of an x-chrom lens was a professional judgment decision made at the examining physician level. Since there were no specific instructions regarding use of the lens or procedures regarding the examination of employees and the transfer of information to supervisors in NUC PR, supervisors of only two employees wearing x-chrom lenses were notified of this medical constraint. In the case of the three employees that are known to have used x-chrom lenses, the employees individually purchased the lenses at their own expense. These purchases were made after each employee failed the color vision test for profile 5A and the MED SV examining physician in Chattanooga

recommended the x-chrom lens as a possible compensatory device. As all three purchased their lenses at TVA's recommendation, it appears that either MED SV initiated the use of the lens or someone other than the three identified used the lens at an earlier time and thus introduced the lens to TVA. The review of medical records by MED SV identified only three individuals with x-chrom lenses which implies that if someone other than the three existed, then that person either no longer works for TVA or his/her medical record does not show the use of the lens. Interviews with the two examining physicians that recommended the use of x-chrom lenses indicated that their acceptability to TVA occurred before they made their recommendation, but they did not know where or by whom the decision to allow x-chrom lenses was made.

On the basis of information available in the literature, it appears that there was no basis for accepting the x-chrom lens as a corrective device for operations personnel. In the absence of a valid basis for accepting the x-chrom lens, it was poor judgment on the part of MED SV to either recommend use of the lens or to accept the use of the lens as a corrective device. In the absence of an official policy or guidance on the use of the x-chrom lens, administrative problems either existed or could have existed in the examining program. Since the use of the lens was not addressed, it is not obvious that examiners were aware of the use of the lens by employees in taking exams. In interviews it was revealed that none of the medical personnel had ever seen an x-chrom lens. It is possible therefore that employees could have used the lens to pass the physical exam. There was no evidence to support this had occurred, however, the lack of a procedural step to assure this was not happening presents the possibility that it could have happened.

With the restriction imposed in 1982, that disallows use of contact lens, the use of the x-chrom lens is also disallowed. This action in effect establishes the policy that the x-chrom lens cannot be used to correct a color deficiency problem. With the initiation of the EEO complaint MED SV for the first time documented, on its position on the unacceptability of the x-chrom lens to compensate for a color deficiency.

B. Adherence to MED SV Procedures and Medical Requirements

Anomolies described in sections III.C.1, .2, and .3 appear to be related to procedural and requirement adherence. With regard to the licensed operators, two were examined in 1977 and found to have color deficiencies that were unacceptable (strong or medium). Both were tested by a consultant opthamologist and given the TVA "yarn test." Both were determined to be acceptable on the basis of those tests. In subsequent years, although the two ASEs continued to have color deficiencies, according to TVA's Orthorator and AO-HRR tests, that were unacceptable (strong or medium), with no further testing the two were evaluated as acceptable.

Understanding that the medical community generally accepts the premise that color deficiencies do not get worse with age unless the eye contracts some disease, then it could be postulated that the 1977 practical tests were still valid and continued Orthorator and AO-HRR testing would confirm no changes. MED SV procedures do not address practical tests other than as included in ANSI/ANS-3.4-1983 which required biennial medical evaluation which NSRS interprets to include any practical test to demonstrate compliance with the standard requirements. NSRS believes that if it is necessary to perform periodic exams to determine acceptability, then if these exams indicate an unacceptable condition, the practical test must be repeated to demonstrate acceptability.

In reviewing the records discussed in sections III.C.1, .2, and .3, it appeared that there were situations where once a person was medically qualified for a position, he/she continued to be qualified regardless of the test results and their relationship to the TVA requirements. This was seen in the case of Employee C who was an the first time he was tested with the AO-HRR. He did not pass it, was approved with unsubstantiated on-the-job demonstrated ability, and was not tested again on AO-HRR even though other test data required it. This was also seen in the case of Employee G whose Orthorator scores had been deteriorating and had never been given an AO-HRR test even though it was required. MED SV procedures described in detail what to do if a person failed to meet the medical requirements, and both cases above could have been handled using those procedures.

Most other annomolies seen in the records included using the wrong profile, not giving the appropriate test, incorrect profile listed in job code book, or poor data. The most probable contributing factor was the expressed position that examinees were looked at clinically rather than from a regulatory basis. In all cases these abnormalities were associated with testing at the plant and did not involve a physician. Implicit is a need for good procedural guidance and an appreciation for what the requirements are meant to accomplish.

While only 11 of over 650 records reviewed by MED SV revealed problems, the kinds of problems identified especially with the accuracy and uniformity of the records, may indicate that other related cases remain unidentified. Record accuracy is particularly important among TVA's licensed operators and medical approval should be based upon acceptable standard medical data and judgment. In the case of the the MED SV review indicated they had demonstrated adequate color vision ability during on-the-job evaluation. Further review by NSRS revealed those evaluations were seven-years old or unsubstantiated.

Considering the importance of medical approval for a licensed operator from both the TVA and the operator standpoints, discussion of the color tests used is in order. The Orthorator is a machine that has been used by the medical profession for years.

TVA has been using it since about 1947. Contained in that device is a pseudoisochromatic plate consisting of six numbers. Satisfactorily reading four of the six numbers precludes the need for any further color testing. The six numbers on that plate are the same ones present in 1947, and NSRS understood there are no replacements with different numbers. While there is no information to presume the following, one could, if his job depended upon it, easily memorize those six numbers. On the other hand, the AO-HRR test consists of 20 individual pseudoisochromatic plates. They, unlike the Orthorator plate, can be shown out of sequence which renders memorization almost impossible. Additionally, they lend themselves to tracing the number with, for example, an artist's brush which could further confirm seeing the correct shape.

Both of these tests are rigorous and, in the case of two individuals with an x-chrom lens, their poor visual accuity versus a color deficiency hampered their ability to see the numbers. A practical test based upon the needs of the job not involving pseudoisochromatic plates should prove worthwhile. However, even in this case, the practical test should be clearly defined and results documented. The test should assure some minimum requirements. Individuals should not be unnecessarily disqualified from a job if they can no longer pass a rigorous physical test, but have satisfactorily demonstrated job performance through a practical test.

With regard to the "two guys" supposedly using x-chrom lenses while taking the SGPO medical examination for class in 1983, they were never identified and thus could not be interviewed. A possible explanation for the allegation is that the EEO complainant talked with Employee E, who come from BLN and who was also taking the entrance examination for SGPO class . The EEO complainant may have misunderstood that Employee E was wearing an x-chrom lense rather than he used to wear an x-chrom lens. The other "guy" from BLN could well have been Employee D, who was known by Employee E. Employee E could have discussed Employee D's color condition and that Employee D had been allowed, in 1981, to enter the SGPO program using an x-chrom lens.

V. CONCLUSIONS

A. Adherence to MED SV procedures and job code color vision requirements were less than adequate for the NSRS-reviewed medical records.

B. The construction of the 5/5A vision profile scoring template probably contributed to medical approval, documented in of some of the reviewed records, when the appropriate test was not given.

C. Documentation regarding the rational for medical approval of personnel with color deficiencies was not always adequate.

D. The lack of a standardized practical color vision test and established requirements regarding when it will be given could result, if the color vision requirements are enforced, in the disqualification of personnel who cannot pass the more rigorous Orthorator and AO-HRR color tests.

E. The color vision test of the Orthorator is more easily circumvented than the AO-HRR test.

F. The NUC PR/MED SV-identified corrective actions should improve the reliability of the medical records and eliminate most of the problems identified in this review.

G. There was no evidence to indicate that TVA has any colorblind licensed operators. There were however three ASEs where there was insufficient information to justify their acceptance.

H. Although x-chrom lenses could have been used prior to the time period when the three identified x-chrom lens users took their exam for SGPO training, there is no evidence to support that x-chrom lenses were used to pass the color examination for SGPO training other than the June to December 1981 time period.

I. There was no evidence to support the allegation that the identified optometrist in Chattanooga was supplying x-chrom lenses to TVA employees.

VI. JUDGMENT OF NEEDS

A. A practical color vision test needs to be developed as soon as possible along with requirements regarding when, how often, and to whom it should be given.

B. The medical requirements, rigor to which they will be followed, testing to ensure medical approval, and documentation to support medical approval for color vision should be reviewed by MED SV in light of the problems found in this investigation and appropriate changes made to procedures, guides, and codes and communicated through training or other suitable mechanism to physicians and nurses responsible for testing and medically approving NUC PR licensed operators and associated career development positions.

C. Once a practical color test has been developed, all licensed personnel within NUC PR and those identified with possible color deficiencies by MED SV should be given a baseline color examination using both the Orthorator and AO-HRR plates, given out of sequence, and where necessary the practical color test. This test should be conducted as soon as possible after the practical test has been developed.

D. All nonlicensed NUC PR personnel in designated career development paths to positions requiring licensing should be given the baseline color examination, described in C above, as part of regularly scheduled physical examinations.

E. A determination should be made by NUC PR regarding the NRC Forms 396 that were sent to NRC which apparently disagreed with the documented medical test results, as to whether or not the forms should be corrected and resubmitted to NRC.

F. MED SV should make a policy decision regarding the use of x-chrom lenses and document and communicate that decision.

VII. REFERENCES

A. Affidavit of the EEO complainant

B. The x-chrom lens by P. Ed LaBissoniere presented at the International Contact Lens Clinic, Winter 1974.

C. "Effects of X-Chrom Lens Wear on Chromatic Discrimination and Steneopsis in Color Deficient Observers," by Ellen R. Matsumato, et al. - American Journal of Optometry and Physiological Optics, Vol. 60, No. 4, 1983