U. S. NUCLEAR REGULATORY COMMISSION

REGION III

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License Nos:	NPF-37; NPF-66
Report Nos:	50-454/98008(DRS); 50-455/98008(DRS)
Licensee:	Commonwealth Edison Company (ComEd)
Facility:	Byron Generating Station, Units 1 & 2
Location:	4450 North German Church Road Byron, IL 61010
Dates:	March 2-6, 1998
Inspectors:	S. Orth, Senior Radiation Specialist D. Nissen, Radiation Specialist
Approved by:	G. Shear, Chief, Plant Support Branch 2 Division of Reactor Safety

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EXECUTIVE SUMMARY

Byron Generating Station, Units 1 & 2
NRC Inspection Reports 50-454/98008; 50-455/98008

This inspection included an announced review of the radiation protection program. Specifically, the inspection focused on the transportation and the solid radioactive waste programs.

Plant Support

- The chemistry staff effectively identified and evaluated an elevated level of nickel impurities in the Unit 1 primary coolant system prior to plant startup. The licensee implemented appropriate actions to reduce the effect of the impurities on plant radioactive source term buildup (Section R1.1).

- A non-cited violation was identified concerning the failure to properly implement radiation protection procedures. The inspector identified that the licensee had failed to properly document the issuance of replacement dosimetry. A dosimetry issue log was required to be completed when replacement dosimetry was issued; however, examples were found where the replacement had not been documented on the log (Section R1.2).

- The radiation protection staff properly determined the activity of radioactive waste shipments via scaling factors. The inspectors noted that the radiation protection staff performed evaluations of radionuclide data and verified that the scaling factors accurately represented the waste streams (Section R1.3).

- The radiation protection staff properly packaged and classified radioactive material and waste shipments in accordance with regulatory requirements. The shipping documentation and low level waste manifests contained the information required by 49 CFR Part 172 and Appendix F of 10 CFR Part 20 (Section R1.4).

- The material condition of the radioactive waste system equipment and rooms was well maintained. Specifically, the inspectors noted that the radioactive tanks and associated equipment showed no visible evidence of leaks or integrity problems (Section R2.1).

- There were notable improvements in the conduct of chemistry sampling and analyses. Chemistry technicians, who were performing routine sampling evolutions demonstrated, proper procedure adherence, analytical techniques, and radiation protection practices. However, a violation was identified concerning the failure to properly implement a chemistry procedure for the degassing of reactor coolant samples, which indicated that long standing procedure adherence problems had not been completely resolved (Section R4.1).

- The quality assurance organization and chemistry supervisors conducted several, critical observations of chemistry technician performance. Although these observations concluded that the chemistry staff had significantly improved in procedural adherence, the inspectors observations indicated that the problem had not been fully resolved (Section R7.1).

Report Details

IV. Plant Support

R1 Radiological Protection and Chemistry (RP&C) Controls

R1.1 Primary Coolant System Chemistry Levels

a. Inspection Scope (IP 84750)

The inspectors reviewed the licensee's investigation of higher than expected nickel and iron concentrations in the Unit 1 primary coolant system. The inspectors reviewed the concentrations of soluble and insoluble iron and nickel present in the Unit 1 primary coolant system between February 16 and March 4, 1998; the chemistry staff's investigation of the source of these elements; and the licensee's actions to mitigate the effects of the elevated concentrations.

b. Observations and Findings

During the licensee's preparations for Unit 1 startup, the licensee experienced a rapid plugging of the reactor coolant system particulate filters. At the time (February 20, 1998), 0.1 micron filters had been in place to remove suspended solids from the primary coolant system. Subsequently, the staff replaced the 0.1 micron filters with 0.45 micron filters to increase the time between required filter changes. Between February 20 and March 4, 1998, the licensee replaced about 11 reactor coolant filters and 7 seal injection filters. As a result of rapid exhaustion of the filters, the chemistry staff performed analyses of the reactor coolant and the particulates on the filters and concluded that the total nickel concentration (both soluble and ..soluble) was much higher than expected. On February 18 - 20, 1998, the chemistry staff determined the total nickel concentration in the coolant to be between about 150 and 250 parts per billion (ppb).

The inspectors reviewed the staff's investigation into the source of the elevated nickel concentrations. Analytical results from offsite laboratories indicated that the nickel and iron were in a metallic form (not an oxide), that the relative fractions of the metals were consistent with 304 stainless steel, and that the average particle size was less than 1 micron. Based on this information, the chemistry staff concluded that the source of the metals was most likely from the removal/replacement of the steam generators (i.e., residual sub-micron particles from the cutting operations on the reactor coolant system piping). Because of the very fine particle size, the staff hypothesized that the particles may have become embedded in the metals such that the routine foreign material exclusion controls could not have removed the impurities.

The staff also properly evaluated the effect of the nickel levels on both fuel integrity and radioactive source term reduction. Review of the chemistry data by both licensee and vendor staffs concluded that the elevated levels would not affect fuel performance. After steam generator replacements, similar levels had been seen in the industry at other sites, without any deleterious effects. In addition, the licensee's actions to reduce the level of impurities was consistent with industry guidance concerning radioactive source term control (i.e., "PWR [pressurized water reactor] Primary Water Chemistry Guidelines: Revision 3," by the Electric Power Research Institute). Since the

identification of the elevated levels, the licensee maintained 0.45 micron filters in the reactor coolant cleanup process. Between February 20, 1998, and February 26, 1998 and prior to increasing reactor coolant temperature above 200 degrees Fahrenheit, the total nickel concentration was reduced from about 250 ppb to about 50 ppb, which was consistent with the levels seen during routine reactor startup evolutions at other, similar pressurized water reactors.

c. Conclusions

The chemistry staff effectively identified and evaluated an elevated level of nickel impurities in the Unit 1 primary coolant system prior to plant startup. The licensee implemented appropriate actions to reduce the effect of the impurities on plant radioactive source term buildup.

R1.2 Dosimetry Logs for Lost Thermoluminescence Dosimeters (TLDs) (IP 83750)

The inspectors reviewed the Radiation Exposure Investigation Reports (REIR) documenting lost TLDs for December 1997 and January 1998. The radiation protection (RP) staff used the REIR to document the determination of dose for the period that was monitored by the lost TLD and to document that the TLD had been lost. When a new TLD was issued, procedure BRP 5200-4 (revision 11), "Issuance of Routine Whole Body and Routine Extremity Dosimeters to Individuals and Tour Groups," required that the new TLD number be documented on the TLD issue log. The clerical staff used the information contained in the issue log to update the computer database, which was used to maintain the exposure records. The inspectors identified one instance when a TLD had been issued and the REIR had been filled out to document the individual's exposure; however, the new TLD issued had not been documented on the log. The licensee determined that the radiation protection technician (RPT) had entered the information directly into the computer but had not documented the issuance in the appropriate log. A licensee investigation found three additional instances where this had occurred. Based on these findings, the inspectors verified that the failure to log the TLDs did not result in any loss of personnel exposure information. As corrective actions, the licensee counseled the RPTs and implemented steps to change the procedure so that the procedure would require the RPTs to enter the TLD issuance directly into the computer. This failure constitutes a violation of minor significance and is being treated as a Non-Cited Violation, consistent with Section IV of the NRC Enforcement Policy (NCV 50-454/98008-01 and 50-455/98008-01).

R1.3 Determinations of the Activity of Radioactive Waste Shipments

a. Inspection Scope (IP 86750)

The inspectors reviewed the licensee's method for determining the activity of radioactive waste shipments. The inspectors reviewed the analyses and verifications which were performed to ensure the validity of radionuclide scaling factors used to determine the activity of hard to detect radionuclides. The inspectors also reviewed the implementation of procedures BRP 5600-7 (Revision 11), "Shipment of Radioactive Materials," and BRP 5600-13 (Revision 2), "Nuclear Radiation Procedure Trending For Shifts in Scaling Factors and Waste Stream Sampling."

b. Observations and Findings

In accordance with 10 CFR 61.55(a)(8), the radiation protection (RP) staff used scaling factors as an indirect method to determine radionuclide activity in radioactive waste shipments. This is done by inferring a concentration of hard to detect radionuclides by applying scaling factors to a known concentration of an easier to detect radionuclide, provided that there is a reasonable assurance that the indirect method can be correlated with actual measurements. As required by procedure BRP 5600-13, the licensee obtained samples from its waste streams, sent the samples to a vendor laboratory for isotopic analyses, and calculated a scaling factor for each hard to determine radionuclide in each sample. The licensee had identified two waste streams: resins and dry active waste (DAW)/filters radioactive material. The resin waste stream was composed of both primary and radioactive waste resins, and the DAW waste stream was a combination of DAW, filters, environmental waste, various radioactive materials, and process wastes such as oils, and charcoal. In accordance with NRC guidance, procedure BRP 5600-13 recommended that each waste stream determined to produce Class B and C wastes be sampled every year and that each waste stream determined to produce Class A wastes be sampled every two years.

In the case of the resin waste streams, samples were collected when possible and sent to the lab on a quarterly basis. The quarterly sampling provided the licensee an opportunity to include samples of resins that were not frequently available for sampling. Following the receipt of the vendor's results, the licensee's procedures required the staff to compare the calculated scaling factors for each waste stream with the current scaling factors for each radionuclide. If any of the scaling factors calculated for an individual waste stream differed from the current scaling factor by a factor of 10 or more, the licensee noted the result as an outlier and investigated it's cause. If the outliers were random, the result was removed from the current scaling factor calculation. The RP staff also compared the calculated scaling factors, both with the outliers and after removing the outliers from the calculation, to identify if any further review of the waste stream was needed. If the outliers were not random, i.e., half or more samples for a stream were outliers, then new, separate scaling factors for the particular waste were determined. Additionally, BRP 5600-13 directed the licensee to compare the vendor supplied results to the licensee's gamma isotopic results. The licensee calculated a ratio of the gamma abundances for each nuclide identified in a waste stream and evaluated discrepancies outside of $\pm$ 20%.

c. Conclusions

The RP staff properly determined the activity of radioactive waste shipments via scaling factors. The inspectors noted that the RP staff performed evaluations of radionuclide data and verified that the scaling factors accurately represented the waste streams (Section R1.3).

R1.4 Conduct of Radioactive Material and Waste Shipments

a. Inspection Scope (IP 86750)

The inspectors reviewed the shipping documents for the following radioactive shipments, including the package classifications, labeling, and shipping papers:

96-29 Empty Liner (surface contaminated object);
98-02 Dewatered Bead Resin;
98-25 Laundry;
98-31 Mechanical Equipment;
98-32 Robotics Equipment; and
98-70 Robotics Equipment.

The inspectors reviewed the shipping documents to determine their compliance with 10 CFR Part 71 and 49 CFR Parts 172 and 173.

b. Observations and Findings

The inspectors observed that the RP staff prepared shipments in accordance with procedures BRP 5600-7 (Revision 11), "Shipment of Radioactive Materials," and BRP 5600-4 (Revision 13), "Completion of Radioactive Material Shipping Record." As allowed by these procedures, the RP staff used a vendor-supplied computer program to classify the shipment and prepare the required shipping documents. Prior to each shipment, the RP staff sampled and analyzed the materials and compared the gamma spectroscopy results to the specific waste stream's scaling factor database. The inspectors reviewed the classification of materials/wastes shipped and noted that shipping documents were properly prepared.

The inspectors observed that the shipping documents and waste manifests contained the information required by 49 CFR Part 172 and Appendix F of 10 CFR Part 20, respectively. The RP staff recorded the activity of shipments using the International System of Units (SI). The shipping documentation also included required emergency response information.

The licensee supplemented the shipping staff with an individual dedicated to processing the laundry shipments for the steam generator replacement project (SGRP). The licensee had determined that the regular station personnel would be able to process the increase in shipping due to the SGRP, except for the amount of laundry that came and went. The worker performed surveys and completed shipping documents; however, the licensee's health physicist in charge of shipping reviewed all of the paper work prior to shipping.

c. Conclusions

The RP staff properly packaged and classified radioactive material and waste shipments in accordance with regulatory requirements. The shipping documentation and low level waste manifests contained the information required by 49 CFR Part 172 and Appendix F of 10 CFR Part 20.

R2 Status of RP&C Facilities and Equipment

R2.1 Material Condition of Radioactive Waste System (IP 86750)

The inspectors performed a material condition inspection of the equipment in several radioactive waste system rooms and reviewed the amount of waste stored onsite with licensee personnel. The inspectors found the rooms and equipment to be in good

condition. Adequate lighting was noted in the rooms, and few action request items were pending for the equipment inspected. The inspectors noted that radioactive waste tanks and associated equipment showed no visible evidence of leaks or system integrity problems. Additionally, the licensee tracked and monitored the waste stored onsite. Overall, the inspectors determined that the material condition of the radioactive waste system equipment and rooms was well maintained.

R4 Staff Knowledge and Performance in RP&C

R4.1 Sampling and Analysis of Primary Coolant

a. Inspection Scope (IPs 84750 and 92904)

The inspectors observed chemistry technicians (CTs) performing routine sampling and analyses of Unit 1 and Unit 2 primary coolant to assess the chemistry staff's progress in correcting procedure adherence deficiencies documented in previous NRC inspection reports (NRC Inspection Reports No. 50-454/95011(DRP) and 50-455/95011(DRP); 50-454/97003(DRS) and 50-455/97003(DRS); and 50-454/97017(DRS) and 50-455/97017 (DRS)). Specifically, the inspectors verified that the activities were performed in accordance with the following procedures:

BCP 100-47 (Revision 2), "Boron Concentration Determination by Automatic Titration;"
BCP 140-12 (Revision 3), "Gas Analysis Using the Hewlett Packard 5890 Gas Chromatograph;"
BCP 300-23 (Revision 18), "Reactor Coolant or Pressurizer Liquid and/or Pressurized Grab Sample;"
BCP 300-27 (Revision 8), "CVCS [chemical and volume control system] Demin Outlet HRSS [high radiation sampling system] Grab Sample;" and
BCP 300-77 (Revision 9), "Preparing a Pressurized Liquid Sample for Analysis Using the Degassing Panel."

b. Observations and Findings

The inspectors observed proper procedure implementation during routine sampling evolutions. On March 5 and 6, 1998, the inspectors observed CTs obtaining primary coolant samples from the primary sample room (i.e., the post accident sampling system (PASS)). The CTs demonstrated proper analytical techniques and RP practices. During the evolutions, the inspectors noted that the CTs were familiar with the instrumentation and valve lineups and anticipated pressure and flow changes. The CTs followed the requirements of procedures BCP 300-23 and BCP 300-27 to obtain the applicable samples.

The inspectors observed that the CTs experienced some challenges when obtaining liquid samples within the Unit 1 sample sink. Specifically, the drain on the sample sink was not capable of handling the volume of water produced during routine sample evolutions. The chemistry staff postulated that tips from disposable, dissolved oxygen testing kits were becoming lodged in the drain and were obstructing the flow path. Consequently, the CTs were forced to pause between samples and allow the water to drain from the sink. The inspectors noted that the drain had overflowed twice in the last 6 months, which spread radioactive contamination within the room; that the current

condition had the potential to result in additional contamination incidents; and that the condition was an encumbrance to the CTs. The chemistry staff acknowledged that obstructions in the drain had been a reoccurring problem and a challenge to the CTs and indicated that an engineering request had been initiated in November of 1996 to evaluate possible changes to the drain line. Although the request remained open, chemistry management indicated that the engineering request had been delayed due to its relatively low priority. Chemistry management also indicated that the staff was evaluating the dissolved oxygen analysis and had acquired an in-line monitor to replace the disposable test kits, potentially reducing the problem.

On March 4-6, 1998, the inspectors also observed CTs analyzing Unit 1 and Unit 2 primary coolant samples for boron concentration and hydrogen content. While performing these analyses, the CTs demonstrated strong analytical technique and effective contamination control practices. However, on March 6, 1998, a CT did not adequately follow procedure BCP 300-77, which resulted in invalid hydrogen and isotopic samples for Unit 1. Specifically, the CT was operating the degassing panel to obtain gas samples from pressurized Unit 1 primary coolant. Prior to withdrawing the gas samples from the degassing panel, step F.9.h of procedure BCP 300-77 required the CT to close valve V8 (degassing panel buret isolation), which provided a constant volume in the degassing panel. The CT performed the procedure and obtained two gas samples from the degassing panel. However, as the CT drained the degassing panel (step F.11 of BCP 300-77), both the CT and an inspector noted that valve V8 had not been properly closed, so the CT isolated the valve. The inspector further concluded that the valve had not been closed when the CT had obtained the two gas samples from the panel and questioned the CT concerning the adequacy of the two samples. After discussions between the CT and the inspector, the CT concluded that the failure to properly close valve V8 had invalidated the current samples. As immediate corrective actions, the licensee discarded the original samples and obtained and analyzed additional Unit 1 samples.

Technical Specification 6.8.1 requires, in part, that written procedures be established, implemented, and maintained covering the applicable procedures recommended in Regulatory Guide 1.33, Appendix A, Revision 2, February 1978. Regulatory Guide 1.33, Appendix A recommends that procedures be implemented which specify chemistry instructions and the calibration of laboratory instruments. The failure to properly implement procedure BCP 300-77 is a violation of Technical Specification 6.8.1 (VIO 50-454/98008-02 and 50-455/98008-02).

c. Conclusions

The inspectors observed notable improvements in the conduct of chemistry sampling and analyses. Chemistry technicians, who were performing routine sampling evolutions demonstrated, proper procedure adherence, analytical techniques, and radiation protection practices. However, a violation was identified concerning the failure to properly implement a chemistry procedure for the degassing of reactor coolant samples, which indicated that long standing procedure adherence problems had not been completely resolved.

R7 Quality Assurance in RP&C Activities

R7.1 Assessments of Chemistry Technician Performance

a. Inspection Scope (IPs 84750 and 92904)

The inspectors reviewed the assessments of the chemistry organization performed by the quality assurance (QA) organization and by the chemistry staff. Specifically, the inspectors reviewed QA field monitoring reports (January 1997 to February 1998) and chemistry field training observations (October 1997 to March 1998) to assess the chemistry staff's progress in correcting procedure adherence deficiencies documented in previous NRC inspection reports (NRC Inspection Report Nos. 50-454/95011(DRP) and 50-455/95011(DRP); 50-454/97003(DRS) and 50-455/97003(DRS); and 50-454/97017(DRS) and 50-455/97017(DRS)). In addition, the inspectors discussed CT performance with members of the QA organization.

c. Observations and Findings

The inspectors noted that the QA organization had performed several field observations of chemistry sampling evolutions over the previous 6 months. The inspectors found the observations to be very thorough and critical of CT performance. During 1997, the QA organization continued to identify problems concerning procedure adherence and radiological work practices, but observations in 1998 had demonstrated a notable improvement. Members of the QA organization indicated that the remaining performance problems were focussed on the performance of two CTs and that the chemistry staff was taking specific actions to address those issues. In one case, the individual was disqualified from certain chemistry activities and was placed in a re-training and qualification program. Although the QA organization's observations indicated progress in correcting chemistry procedure adherence problems, the inspectors observations indicated that the problem had been reduced but not completely resolved (Section R4.1).

During 1997 and 1998, the laboratory supervisors had increased their oversight of chemistry sampling and analysis. The inspectors noted that the two laboratory supervisors performed several field observations over the previous 6 month period. Generally, the supervisors' observations were consistent with the QA organization's observations. In addition, the QA organization assisted the chemistry supervisors in improving the quality of their observations and in providing more critical assessments of performance. The inspectors noted an improvement in the documentation of these observations; however, the inspectors also noted that performance problems identified during the chemistry supervisors' observations were not entered into the licensee's problem identification system (i.e., problem identification forms (PIFs)). The supervisors indicated that the problems they observed were not routinely at a high enough threshold or safety significance to initiate a PIF. Although the staff appeared to be correcting the problems as they occurred, the staff's reluctance to initiate a PIF could potentially result in the failure to identify a repetitive problem or to ensure adequate, generic corrective actions.

c. Conclusions

The QA organization and chemistry supervisors conducted several, critical observations of CT performance. Although these observations concluded that the chemistry staff nad significantly improved in procedural adherence, the inspectors observations indicated that the problem had not been fully resolved.

R8 Miscellaneous RP&C Issues

R8.1 (Closed) Violation Nos. 50-454/97003-02b and 50-455/97003-02b: The inspectors reviewed the effectiveness of the licensee's corrective actions for a violation concerning the failure to adhere to chemistry procedures. Although the licensee had implemented corrective actions for this violation, minor problems continued to be identified (NRC inspection reports 50-454/97017(DRS) and 50-455/97017(DRS)). As documented in Section R4.1, the inspectors noted an improvement in CT performance and procedure adherence. However, the inspectors identified an additional violation of chemistry procedures concerning the degassing of pressurized Unit 1 primary coolant, which was the subject of the original violation. Although progress was evident, the inspectors observations indicated that procedural adherence problems had not been fully resolved. Additional corrective actions and future licensee performance in this area will be reviewed as follow-up to VIO 50-454/98008-02 and 50-455/98008-02. This item is closed.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on March 6, 1998. The licensee acknowledged the findings presented and did not identify any proprietary information.

PARTIAL LIST OF PERSONS CONTACTED

J. Bauer, Health Physics Supervisor
R. Colglazier, NRC Coordinator
W.Grundmann, Chemistry Supervisor
D. Herrmann, Radioactive Waste Coordinator
K. Kofron, Station Manager
M. Marchionda, Technical Lead Health Physicist
S. Robinson, Technical Health Physicist

INSPECTION PROCEDURES USED

IP 83750	Occupational Radiation Exposure
IP 84750	Radioactive Waste Treatment, and Effluent and Environmental Monitoring
IP 86750	Solid Radioactive Waste Management and Transportation of Radioactive Materials

ITEMS OPENED, CLOSED OR DISCUSSED

Open

50-454/455-98008-01	NCV	Failure to document replacement TLDs in accordance with procedure.
50-454/455-98008-02	VIO	Failure to follow chemistry procedures.

Closed

50-454/455-98008-01	NCV	Failure to document replacement TLDs in accordance with procedure.
50-454/455-97003-02(b)	VIO	Failure to follow chemistry procedures.

LIST OF ACRONYMS USED

CT	Chemistry Technician
DAW	Dry Active Waste
NCV	Non-Cited Violation
PPB	Parts Per Billion
PIF	Problem Identification Form
PWR	Pressurized Water Reactor
QA	Quality Assurance
REIR	Radiation Exposure Investigation Report
RP	Radiation Protection
RPT	Radiation Protection Technician
SGRP	Steam Generator Replacement Project
SI	System International
TLD	Thermoluminescence Dosimeter
TS	Technical Specifications
VIO	Violation

LIST OF DOCUMENTS REVIEWED

Byron Procedures:

BCP 100-47 (Revision 2), "Boron Concentration Determination by Automatic Titration;"
BCP 140-12 (Revision 3), "Gas Analysis Using the Hewlett Packard 6890 Gas Chromatograph;"
BCP 300-23 (Revision 18), "Reactor Coolant or Pressurizer Liquid and/or Pressurized Grab Sample;"
BCP 300-27 (Revision 8), "CVCS [chemical and volume control system] Demin Outlet HRSS [high radiation sampling system] Grab Sample;"
BCP 300-77 (Revision 9), "Preparing a Pressurized Liquid Sample for Analysis Using the Degassing Panel;"
BRP 5600-7 (Revision 11), "Shipment of Radioactive Materials;"
BRP 5600-4 (Revision 13), "Completion of Radioactive Material Shipping Record;" and
BRP 5600-13 (Revision 2), "Nuclear Radiation Procedure Trending For Shifts in Scaling Factors and Waste Stream Sampling."

Problem Identification Form No. B1998-00834

Engineering Request No. ER9605803, initiated November 20, 1996.

Laboratory Supervisor Field Training/Observations dated July 11, 1997, through January 30, 1998, by M. Johnson.

Laboratory Supervisor Field Training/Observations dated July 15, 1997, through March 3, 1998, by D. Olsen.

Quality Assurance Field Monitoring Reports Nos. 06-97-02-0061, 06-97-05-0037, 06-97-05-0038, 06-97-05-0057, 06-97-06-0001, 06-97-06-0037, 06-97-06-0040, 06-97-07-0001, 06-97-08-0066, 06-97-08-0068, 06-97-08-0074, 06-97-10-0010, 06-97-10-0042, 06-97-10-0058, 06-97-10-0059, 06-97-10-0063, 06-97-10-0113, 06-97-10-0118, 06-97-11-0067, 06-97-12-0134, 06-98-01-0030, 06-98-01-0040, 06-98-01-0056, 06-98-01-0060, and 06-98-01-0066.