Final Status Survey Report

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For

Saxton Nuclear Experimental Corporation Saxton Steam Generating Station Structural Surfaces – Spray Pump Area SS9, SS11



Prepared by GPU Nuclear, Inc.

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Executive Summary

This report presents the results and conclusions of the final status survey (FSS) of the Class 1, 2, and 3 structural surfaces of the Saxton Nuclear Experimental Corporation (SNEC) facility designated as SS9-1, SS9-2, SS11-1, and SS11-2. This FSS includes surveys of residual structural surfaces (e.g. concrete) in the Spray Pump Area (pump pit and pump room) of the Saxton Steam Generating Station of the SNEC site and was conducted in the summer of 2004.

The FSS was performed in accordance with the SNEC License Termination Plan (LTP). The Spray Pump Area survey area was divided into four survey units. Each unit consisted of relatively flat residual structural surfaces. Data was collected from each survey unit in accordance with the specific survey design data collection requirements. The following is a summary of the measurements performed:

- 1) Direct Gas Flow Proportional Counter (GFPC) and Nal detector scans of all or part of all four survey units covering about 44% of the actual surface area.
- 2) Fifty fixed point static GFPC measurements.

The collected FSS survey data demonstrate that the 200 square meters of the SSGS Spray Pump Area meets the radiological release criteria for unrestricted use specified in 10CFR20.1402. Therefore GPU Nuclear, Inc. concludes that the area meets the NRC requirements and may be released for unrestricted use.

1.0 Purpose and Scope

This report presents the results and conclusions of the final status survey of the residual structural surfaces in the SSGS Spray Pump Area (four survey units designated SS9-1, SS9-2, SS11-1, and SS11-2) and west of the SNEC facility. It provides the information required by 10CFR50.82(a)(11) and the SNEC license termination plan (LTP) to demonstrate that this area meets the radiological criteria for unrestricted use specified in 10CFR20.1402.

This report describes the radiological data collected in nine survey units consisting of one Class1, two Class 2, and one Class 3 survey units of residual structural surface in the SSGS Spray Pump area. This report only addresses the FSS performed on this specific area . The format of this report follows the guidance contained in reference 9.2.

2.0 Survey Area Description

The SSGS Spray Pump Area is Class 1, 2, or 3 impacted structural surface located underground to the west of the SNEC facility. The Spray Pump Area is connected to the discharge tunnel through the 'Transition Area'. The survey unit encompasses about 200 square meters of concrete. Because the classification varies spatially in the area, the survey area has been divided into four survey units. Layout of the survey area and individual units are shown in Attachment 1-1 of Appendix A and Attachment 1 of Appendix B. The four survey units are discussed below. The individual survey unit designations are derived from table 5-2 of the SNEC LTP (reference 9.3).

Survey unit SS9-1 is a Class 1 residual concrete surface in the SSGS Spray Pump Area. It consists of the spray pump pit floor and walls up to the floor of the spray pump building. SS9-1 as surveyed corresponds to SS9 and SS10 from table 5-2 of the SNEC LTP. SS9 is Class 1 and SS10 is Class 2, so survey of SS9-1 as Class 1 is conservative classification. The survey unit is approximately 52 square meters. Appendix A contains drawings showing the layout of the survey unit.

Survey unit SS9-2 is a Class 2 residual concrete surface in the SSGS Spray Pump Area. It consists of the floor area of the spray pump room. This area is not explicitly defined in table 5-2 of the SNEC LTP, but is between SS10 (Class 2) and SS11 (Class 3) so the Class 2 designation is appropriate. The survey unit is approximately 30 square meters. Appendix B contains drawings showing the layout of the survey unit.

Survey unit SS11-1 is a Class 2 residual concrete surface in the SSGS Spray Pump Area. It consists of the lower 2 meters of the walls of the spray pump room. SS11 is defined as Class 3 in table 5-2 of the SNEC LTP, so designation of this lowewr portion as Class 2 is conservative. The survey unit is approximately 60 square meters. Appendix B contains drawings showing the layout of the survey unit.

Survey unit SS11-2 is a Class 3 residual concrete surface in the SSGS Spray Pump Area. It consists of walls of the spray pump room higher than 2 meters above the floor. The survey unit is approximately 58 square meters. Appendix B contains drawings showing the layout of the survey unit.

3.0 Operating History

3.1 Plant Operation

The Saxton Nuclear Experimental Corporation (SNEC) facility included a pressurized water reactor (PWR), which was licensed to operate at 23.5 megawatts thermal (23.5 MWTh). The reactor, containment vessel and support buildings have all been removed. The facility is owned by the Saxton Nuclear Experimental Corporation and is licensed by GPU Nuclear, Inc. The SNEC facility is maintained under a Title 10 Part 50 license and associated Technical Specifications. In 1972, the license was amended to possess but not operate the SNEC reactor.

The facility was built from 1960 to 1962 and operated from 1962 to 1972 primarily as a research and training reactor. Steam from the SNEC reactor was directed to the adjacent Saxton Steam Generating Station (SSGS) to generate electricity. Other shared systems also introduced SNEC activity into the SSGS and the main SNEC liquid discharge entered the SSGS discharge tunnel. After shutdown in 1972, the SNEC facility was placed in a condition equivalent to the current SAFSTOR status. Since then, it has been maintained in a monitored condition. The fuel was removed in 1972 and shipped to a (now DOE) facility at Savannah River, SC, who is now the owner of the fuel. As a result of this, neither SNEC nor GPU Nuclear, Inc. has any further responsibility for the spent fuel from the SNEC facility. The building and structures that supported reactor operation were partially decontaminated by 1974. The SSGS was dismantled circa 1974.

In the late 1980s and through the 1990s, additional decontamination and disassembly of the containment vessel and support buildings and final equipment and large component removal was completed. Final decontamination and dismantlement of the reactor support structures and buildings was completed in 1992. Large component structures, pressurizer, steam generator, and reactor vessel were removed in late 1998. Containment vessel removal (to below grade) and backfill was completed in late 2003. Currently, decontamination, disassembly and demolition of the SNEC facility buildings and equipment has been completed and the facility is in the process of Final Status Survey for unrestricted release and license termination.

3.2 Survey Area Remediation Status

The Spray Pump Area had the potential for contamination as a result of shared water systems which introduced contamination into the SSGS and the discharge tunnel. The Spray Pump Area is connected to the discharge tunnel. No remediation was required in the Spray Pump Area but general housekeeping in order to improve survey conditions and groundwater in-leakage control were required.

4.0 Site Release Criteria

The site release criteria applied to the structural surface areas of the SSGS Spray Pump area correspond to the radiological dose criteria for unrestricted use per 10CFR20.1402. The dose criteria is met "if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)".

Levels of residual radioactivity that correspond to the allowable dose to meet the site or survey unit release criteria for structural surfaces were derived by analyses using a building re-use scenario. The dose modeling for this scenario is explained in the SNEC LTP (reference 9.3). The derived concentration guideline levels (DCGL) shown in Table 5-1 of the SNEC LTP form the basis for satisfying the site release criteria.

Residual radioactivity sample results for the surfaces were used to calculate a surrogate Cs137 DCGL. The adjusted surrogate DCGL was developed using the methodology described in the SNEC LTP section 5.2.3.2.3 based on nuclide specific DCGLs from Table 5-1 of the LTP.

An adjustment was made to the surrogate Cs137 DCGL to address the de-listed radionuclides as described in the LTP section 6.2.2.3. SNEC has instituted an administrative limit of 75% of the DCGL for all measurement results. The de-listed radionuclides are conservatively accounted for in this 25% reduction since the de-listed radionuclides were only 4.7% of the dose contribution. These adjustment factors are discussed in section 6 of the SNEC LTP.

5.0 Final Status Survey Design and DQO

The SNEC calculation providing the design of the survey for these survey units is provided in Appendices A and B. Scan measurements were conducted over approximately 100% of the surface of the Class 1 survey unit. Scan coverage of the two Class 2 survey units was approximately 28% and 35%. Scans of the

Class 3 survey unit covered approximately 10.7% of the survey unit Scans were conducted using a hand-held Gas Flow Proportional Counter (GFPC) and / or Nal detector.

The number of fixed measurement points was determined by using the COMPASS computer program (reference 9.5, attachment 6 of appendix A and attachment 5 of appendix B). These points were located on survey maps using the Visual Sample Plan program (reference 9.6, attachment 7 of appendix A and attachment 6 of appendix B). Measurements were collected with the GFPC using a long fixed count at each point.

The survey design uses a surrogate Cs137/gross beta effective DCGL developed from radionuclide mix analyses from samples collected before the Final Status Survey in the vicinity of the survey unit. The mix was based on radionuclide mix data (including the hard-to-detects listed in Table 5-1 of the LTP) from the discharge tunnel (attachment 4 of appendix A).

Cs137, Co60, Am241, Ni63, Pu238, and Pu239 were positively detected in one or more of these samples and are accounted for in the adjusted surrogate DCGL. The following table (Table 5.0-1) presents the Data Quality Objectives (DQO) and other relevant design information from the survey design packages.

DQO/Design Parameter	SS9-1	SS9-2, SS11-1	SS11-2
SNEC Design Calc. #	E900-04-015	E900-04-017	E900-04-017
MARSSIM Classification	1	2	3
Survey Unit Area (m²)	52	30, 60	58
Statistical Test	WRS	WRS	WRS
Type 1 decision error (α)	0.05	0.05	0.05
Type 2 decision error (β)	0.1	0.1	0.1
LBGR (cpm)	350	500	500
Estimated o (dpm/100cm ²)	45.4	34.5	34.5
Relative Shift (Δ/σ)	1.6	2.7	2.7
Number of static points	15	13, 11	11
DCGLw (Cs137 dpm/100cm ²)	8807	8807	8807
75% Admin Limit (Cs137 dpm/100cm²)	6605	6605	6605
DCGLw (Cs137 ncpm)	424	593	593
Action Level (cpm)	350 net GFPC 200 gross Nal	500 net	500 net
Scan MDC (dpm/100cm²)	2644	1817	1817
SNEC Survey Request #	SR158	SR165	SR165
Scan Survey Instrument	L2350-1 w/ 43-68B, L2350-1 w/ 44-10	L2350-1 with 43-68B	L2350-1 with 43-68B

Table 5.0-1 – DQO/Design

6.0 Final Status Survey Results

The following sections provide the survey summary results for each survey unit as required by the respective design. Summary data was taken from references 9.9 and 9.10 which are filed in the SNEC history files.

6.1 Survey Unit SS9-1

6.1.1 Scan survey

Scan measurements were made in SS9-1 using a hand-held GFPC detector with an MDCscan of 2644 dpm/100cm² (table 3 on page 3 of appendix A). The scan action level was 350 net cpm (section 2.1.5 on page 3 of appendix A). The adjusted surrogate Cs137 gross beta DCGLw for this survey unit was 8807 dpm/100cm² and the 75% administrative limit was 6605 dpm/100cm² (attachment

4-5 of appendix A). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit. Scan measurements were also made using a hand-held Nal detector with an MDCscan of 2.7 pCi/g (table 4 on page 3 of appendix A). The scan action level was 200 gross cpm (section 2.2.3 on page 3 of appendix A).

Of the 52 square meters of this survey unit scanning was conducted on all 52 square meters of the surface. Therefore 100 percent of the survey unit was scanned. All 43-68 GFPC scans were less than the 350 net cpm action level. All 44-10 Nal scans were less than the 200 gross cpm action level.

6.1.2 Fixed point measurements

Fifteen random start systematic fixed point measurement locations were defined for the survey unit. Each fixed point was measured with the 43-68 GFPC detector. Based on a conservative relative shift of about 1.6 a minimum of 13 fixed points were required.

None of the design fixed point measurements in SS9-1 had results in excess of the action level of 424 net cpm for the GFPC measurements. The table below (Table 6.1-1) shows the gross beta GFPC results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the GFPC measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift, and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

Point	Unshielded	
Number	GFPC cpm	
1	294	
2	276	
3	264	
4	279	
5	219	
6	248	
7	219	
8	220	
9	211	
10	228	
11	213	
12	277	
13	227	
14	239	
15	250	
Mean	244	
Std Dev	27.7	
Min	211	
Max	294	

Table 6.1-1 – Fixed point results for SS9-1

6.2 Survey Unit SS9-2

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6.2.1 Scan survey

Scan measurements were made in SS9-2 using a hand-held GFPC detector with an MDCscan of 1817 dpm/100cm² (table 3 on page 3 of appendix B). The scan action level was 500 net cpm (table 4 on page 3 of appendix B).The adjusted surrogate Cs137 gross beta DCGLw for this survey unit was 8807 dpm/100cm² and the 75% administrative limit was 6605 dpm/100cm² (attachment 4-5 of appendix A). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Of the 30 square meters of this survey unit scanning was conducted on 8.5 square meters of the surface. Therefore about 28 percent of this Class 2 survey unit was scanned. All 43-68 GFPC scans were less than the 500 net cpm action level.

6.2.2 Fixed point measurements

Thirteen random start systematic fixed point measurement locations were defined for the survey unit. Each fixed point was measured with the 43-68 GFPC detector. Based on a conservative relative shift of about 2.7 a minimum of 9 fixed points were required.

None of the design fixed point measurements in SS9-2 had results in excess of the action level of 593 net cpm for the GFPC measurements. The table below (Table 6.2-1) shows the gross beta GFPC results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the GFPC measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift, and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

Point	Unshielded	
Number	GFPC cpm	
1	365	
2	349	
3	319	
4	290	
5	323	
6	303	
7	340	
8	308	
9	307	
10	318	
11	321	
12	294	
13	338	
Mean	321	
Std Dev	21.9	
Min	290	
Max	365	

Table 6.2-1 – Fixed point results for SS9-2

6.3 Survey Unit SS11-1

6.3.1 Scan survey

Scan measurements were made in SS11-1 using a hand-held GFPC detector with an MDCscan of 1817 dpm/100cm² (table 3 on page 3 of appendix B). The scan action level was 500 net cpm (table 4 on page 3 of appendix B).The adjusted surrogate Cs137 gross beta DCGLw for this survey unit was 8807 dpm/100cm² and the 75% administrative limit was 6605 dpm/100cm² (attachment 4-5 of appendix A). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Of the 60 square meters of this survey unit scanning was conducted on 21 square meters of the surface. Therefore about 35 percent of this Class 2 survey unit was scanned. All 43-68 GFPC scans were less than the 500 net cpm action level.

6.3.2 Fixed point measurements

Eleven random start systematic fixed point measurement locations were defined for the survey unit. Each fixed point was measured with the 43-68 GFPC detector. Based on a conservative relative shift of about 2.7 a minimum of 9 fixed points were required.

None of the design fixed point measurements in SS11-1 had results in excess of the action level of 593 net cpm for the GFPC measurements. The table below (Table 6.3-1) shows the gross beta GFPC results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the GFPC measurements collected from the survey unit was slightly higher than the variability assumed in the survey design. However, since the LGBR used was much greater than the typical 50% of the DCGL, the relative shift would be unaffected by the slightly higher variability if combined with a slightly less conservative LBGR. In addition, the design required 11 measurements rather than the minimum of 9. Therefore, the assessment of variability, relative shift, and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

Point	Unshielded	
	GFPC cpm	
А	245	
В	270	
С	316	
D	298	
E	254	
F	292	
G	280	
Н	305	
1	314	
J	359	
К	359	
Mean	299	
Std Dev	37.3	
Min	245	
Max	359	

Table 6.3-1 – Fixed point results for SS11-1

6.4 Survey Unit SS11-2

6.4.1 Scan survey

Scan measurements were made in SS11-2 using a hand-held GFPC detector with an MDCscan of 1817 dpm/100cm² (table 3 on page 3 of appendix B). The scan action level was 500 net cpm (table 4 on page 3 of appendix B).The adjusted surrogate Cs137 gross beta DCGLw for this survey unit was 8807 dpm/100cm² and the 75% administrative limit was 6605 dpm/100cm² (attachment 4-5 of appendix A). No fixed point number adjustment was needed in this case because the MDCscan was below the 75% administrative limit.

Of the 58 square meters of this survey unit scanning was conducted on 6.2 square meters of the surface. Therefore about 10.7 percent of the Class 3 survey unit was scanned. All 43-68 GFPC scans were less than the 500 net cpm action level.

6.4.2 Fixed point measurements

Eleven random start systematic fixed point measurement locations were defined for the survey unit. Each fixed point was measured with the 43-68 GFPC detector. Based on a conservative relative shift of about 2.7 a minimum of 9 fixed points were required.

None of the design fixed point measurements in SS11-2 had results in excess of the action level of 593 net cpm for the GFPC measurements. The table below (Table 6.4-1) shows the gross beta GFPC results for each fixed point measurement, along with the mean, standard deviation and range of the fixed point measurement data.

The standard deviation of the GFPC measurements collected from the survey unit was less than the variability assumed in the survey design. Therefore, the assessment of variability, relative shift, and number of fixed point measurements required is consistent between the survey design and the survey results. Based on this, no changes to the survey design or additional measurements are required.

Point	Unshielded	
Number	GFPC cpm	
1	287	
2	294	
3	324	
4	286	
5	279	
6	298	
7	315	
8	336	
9	316	
10	307	
11	333	
Mean	307	
Std Dev	19.6	
Min	279	
Max	336	

Table 6.4-1 – Fixed point results for SS11-2

7.0 Data Assessment

7.1 Assessment Criteria

The final status survey data has been reviewed to verify authenticity, appropriate documentation, quality, and technical acceptability. The review criteria for data acceptability are:

- 1) The instruments used to collect the data were capable of detecting the radiation of the radionuclide of interest at or below the investigation levels.
- 2) The calibration of the instruments used to collect the data was current and radioactive sources used for calibration were traceable to recognized standards or calibration organizations.
- 3) Instrument response was checked before and, when required, after instrument use each day data was collected.
- 4) Survey team personnel were properly trained in the applicable survey techniques and training was documented.
- 5) The MDCs and the assumptions used to develop them were appropriate for the instruments and the survey methods used to collect the data.
- 6) The survey methods used to collect the data were appropriate for the media and types of radiation being measured.
- 7) Special instrument methods used to collect data were applied as warranted by survey conditions, and were documented in accordance with an approved site Survey Request procedure.
- 8) The custody of samples that were sent for off-site analysis were tracked from the point of collection until final results were provided.
- 9) The final status survey data consists of qualified measurement results representative of current facility status and were collected in accordance with the applicable survey design package.

If a discrepancy existed where one or more criteria were not met, the discrepancy was reviewed and corrective action taken (as appropriate) in accordance with site procedures.

The statistical test does not need to be performed for this final status survey since the data clearly show that the survey unit meets the release criteria because all measurements in the survey units are less than or equal to the DCGLw.

7.2 Summary of Overall Results

SS9-1 had no alarm points during GFPC and Nal scan surveys of approximately 100% of the surface. Scan MDCs were adequate. Fifteen fixed point GFPC measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS9-2 had no alarm points during GFPC scan surveys of approximately 28% of the surface. Scan MDCs were adequate. Thirteen fixed point GFPC measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS11-1 had no alarm points during GFPC scan surveys of approximately 35% of the surface. Scan MDCs were adequate. Eleven fixed point GFPC measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

SS11-2 had no alarm points during GFPC scan surveys of approximately 10.7% of the surface. Scan MDCs were adequate. Eleven fixed point GFPC measurements were all less than the DCGLw. Scan fraction and number of fixed point measurements meets LTP and MARSSIM requirements.

7.3 Survey Variations (Design, survey request, LTP)

7.3.1 Initial static measurements in SS9-2 indicated elevated activity. Investigation concluded that the results were affected by transient radon daughter products. The survey was repeated. The second set of data are reported herein.

7.4 QC comparisons

7.4.1 Scan surveys

Numerous areas were rescanned as QC duplicates with the hand-held detectors. The QC hand-held GFPC and Nal rescans did not identify any activity above alarm points and so are in agreement with the primary scans because the conclusion that the survey area passes is supported by both the initial and QC results (reference 9.8). GFPC QC scans were conducted on 8.8 m² of the survey area, which represents about 10 percent of the 87.7 m² originally scanned by GFPC. Nal QC scans were conducted on 4.7 m² of the survey area, which represents about 9.0 percent of the 52 m² originally scanned by Nal. These each exceed the minimum 5% required.

7.4.2 Fixed Point measurements

Three fixed point measurements from SS11-2 received QC duplicate GFPC measurements. These duplicates had good agreement as shown in the table below (Table 7.4-1) because the conclusion that the survey area passes is supported by both the initial and QC results (reference 9.8). Three QC splits out of 50 measurements represents 6 percent of the fixed point measurements. This exceeds the 5% minimum criterion.

Fixed Point	Result (cpm)	QC Result (cpm)
SS11-2 A	245	281
SS11-2 C	316	290
SS11-2 E	254	230

Table 7.4-1 Spray Pump Area QC Duplicate comparison

8.0 Final Survey Conclusions

The Structural Surfaces of the SSGS Spray Pump Area survey units SS9-1 SS9-2, SS11-1, and SS11-2 final status survey was performed in accordance with the SNEC LTP, site procedures, design calculations, and Survey Request requirements. FSS data was collected to meet and/or exceed the quantity specified or required for each survey unit design. The survey data for each survey unit meets the following conditions:

- 1) The average residual radioactivity on the surfaces is less than the derived surrogate DCGLw in all of the survey units.
- 2) All measurements were less than the DCGLw in all of the survey units.

These conditions satisfy the release criteria established in the SNEC LTP and the radiological criteria for unrestricted use given in 10CFR20.1402. Therefore it is concluded that the SNEC Structural Surface Areas of the SSGS Spray Pump Area designated SS9-1, SS9-2, SS11-1, and SS11-2 are suitable for unrestricted release.

9.0 <u>References</u>

- 9.1 SNEC Facility Site area grid map Drawing number SNECRM-020
- 9.2 SNEC procedure E900-ADM-4500.60 "Final Status Survey Report"
- 9.3 SNEC License Termination Plan
- 9.4 NUREG 1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), revision 1 August 2000
- 9.5 COMPASS computer program, Version 1.0.0, Oak Ridge Institute for Science and Education
- 9.6 VISUAL SAMPLE PLAN computer program, Version 3.0, Battelle Memorial Institute
- 9.7 SNEC procedure E900-IMP-4500.59, "Final Site Survey Planning and DQA"
- 9.8 SNEC procedure E900-IMP-4520.04, "Survey Methodology to Support SNEC License Termination"
- 9.9 SNEC Survey Request (SR) # SR158
- 9.10 SNEC Survey Request (SR) # SR165

10.0 <u>Appendices</u>

Appendix A - SNEC Calculation E900-04-015 – "Spray Pump Pit – Survey Design" (10 pages plus numerous attachments) Appendix B - SNEC Calculation E900-04-017 – "Upper Spray Pump Area & DT Entrance - Survey Design" (9 pages plus numerous attachments)