HANFORD TECHNICAL RECORD

DECLASSIFIED

DOCUMENT NO. HW-40707

[redacted]

(CLASSIFICATION)

GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION — RICHLAND, WASHINGTON

DATE: December 30, 1955

COPY NO. AND SERIES: [redacted]

FILE DESIGNATION: 300 ... CLASSIFIED FILES

[X] [redacted] CONTAINS RESTRICTED DATA AS DEFINED [redacted] ENERGY ACT OF 1954 ITS TRANSMITTAL [redacted] ITS CONTENTS IN ANY MANNER [redacted] UNAUTH[redacted] PERSON IS PROHIBITED.

[ ] OTHER OFFICIAL CLASSIFIED [redacted]FORMATION

THI... ECTING THE... STATES WIT... AWS, TIT... ANS- MIS... TO ... BY LAW...

THIS DOCUMENT IS PUBLICLY AVAILABLE

TITLE

THE APPLICATION OF IN-LINE INSTRUMENTS FOR SEPARATIONS PROCESS CONTROL FISCAL YEARS 1956, 1957, 1958

AUTHOR

A. E. Smith and G. J. Alkire

THIS DOCUME[redacted]UST NOT BE LEFT UNATTENDED OR WHERE AN UN[redacted]THORIZED PE[redacted] HAVE ACCESS TO IT. WH[redacted] GUARDED [redacted] CLASS[redacted] FIL... THI[redacted]JECT A... O[redacted]SIDENCE ...AIN THEM FR... TO SIGN IN THE SPACE PROVIDED BELOW.

DOCUMENT **DOES NOT** CONTAIN ECI

Reviewed by: JB FLYNN Date: 2/06/97

ROUTE TO:	PAYROLL NO.	LOCATION	SIGNATURE	DATE
[illegible]	1045	3707 C	[illegible]	
[illegible]	[redacted]	[redacted]	[illegible]	1-13-56

RECORD COPY

BEST AVAILABLE COPY

Indefinite Retention ______ Disposal Date ______

Authority ______ Authority ______

DECLASSIFIED

NOT UCNI

C-3195-D

[redacted]

(CLASSIFICATION)

[redacted] [redacted] DECLASSIFIED HW-40707

BEST AVAILABLE COPY

This document consists of 9 pages. [redacted]

THE APPLICATION OF IN-LINE INSTRUMENTS FOR SEPARATIONS PROCESS CONTROL FISCAL YEARS 1956, 1957, 1958

NOT UCNI

CLASSIFICATION CANCELLED
Per DOC May 1973
By B. Roberts 3/8/74

SPECIAL RE-REVIEW
FINAL DETERMINATION
DECLASSIFICATION CONFIRMED
BY [signature] DATE 7-9-81
BY [signature] DATE 7-10-81
PM Eick 5-19-98
NOT UCNI

By

A. E. Smith

and

G. J. Alkire

Separations Equipment Development
Separations Technology Section
ENGINEERING DEPARTMENT

December 30, 1955

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Operated for the Atomic Energy Commission by the General Electric Company under Contract # W-31-109-Eng-52

DECLASSIFIED

[redacted] DATA [redacted]

This [redacted] Data as [redacted] the Atomic Energy Act of 1954. Its [redacted] con-tents in any manner to an unauthorized person is prohibited

[redacted]

DISTRIBUTION

1. G. J. Alkire
2. R. H. Beaton
3. R. J. Brouns
4. V. R. Chapman - O. F. Beaulieu
5. H. C. Copeland
6. J. B. Fecht
7. K. M. Harmon
8. M. K. Harmon
9. O. F. Hill
10. E. R. Irish
11. R. T. Jessen - C. R. Anderson
12. J. E. Kaveckis
13. C. E. Kent - C. F. Falk
14. L. M. Knights
15. E. B. Montgomery
16. W. H. Reas
17. E. L. Reed
18. R. B. Richards
19. H. P. Shaw
20. M. T. Slind - N. T. Hildreth
21. R. J. Sloat
22. A. E. Smith
23. R. E. Smith
24. R. E. Tomlinson
25. J. H. Warren
26. 300 Files
27. A. E. C. - H. O. O.

28 - 35. Extra

THE APPLICATION OF IN-LINE INSTRUMENTS FOR SEPARATIONS PROCESS CONTROL FISCAL YEARS 1956, 1957, 1958

INTRODUCTION

The employment of continuous separations processes at H.A.P.O. has created a need for continuous process control in order that these plants can operate at maximum capacity and efficiency. The present control procedure which requires manual sampling followed by laboratory analysis introduces an undesirable delay between the time the analysis data are deemed necessary and the time when the data are available. The application of in-line instruments at key points in the process will overcome this undesirable delay and simultaneously provide a degree of process control that cannot be achieved otherwise. In-line instruments will also provide the foundation for automatic process control.

The Engineering Department has, during the past three years, engaged in research and development aimed at establishing methods and developing instruments suitable for in-line instrumentation of H.A.P.O. Separations Plants. As a part of this program the first prototype in-line instruments were installed in the Metal Recovery Plant during Calendar Year 1953[1,2,3,4,5]. The Metal Recovery installation included a gamma scintillation monitor for the final uranium stream, colorimeter for uranium in feed streams, polarograph for uranium in waste streams and a pH monitor for neutralized wastes. Also, during 1954, gamma scintillation monitors, uranium colorimeters, uranium polarographs, pH monitors, a gamma absorptometer and an alpha printer for total alpha activity were installed in the Hot Semiworks to develop these instruments further for plant application[6-18]. During 1955, a prototype off-gas iodine^{131} monitor was installed at T-Plant[19].

The original Purex Plant design included 18 in-line instruments, and during Fiscal Year 1955, four additional in-line monitors were included in the Purex Facility Revisions, Project CA-513-E[20]. It has been proposed that a total of fifteen in-line instruments be installed in the Redox and Purex Plants in Fiscal Year 1956[21]. Fiscal Years 1957 and 1958 will see wide application of in-line instruments now developed or currently under research or development[22,23].

OBJECTIVE

It is the objective of this report to present (1) the separations plants requirements for in-line instrumentation and (2) a tentative schedule for application of in-line instruments.

SUMMARY

A complete survey of the separations plant requirements for in-line instrumentation has disclosed that at least fifteen different instrument types will be required in about 190 installations. These requirements can be met by the end of Fiscal Year 1958 through continued research and development effort. A total of fifteen installations can be made on Fiscal Year 1956 construction funds if they are available. It is predicted that development progress will permit an additional thirty-six installations during Fiscal Year 1957.

PLANT REQUIREMENTS

A complete survey of separations plant requirements has disclosed the need for at least fifteen different instrument types in about 190 installations. The points where in-line analyses are required in the Redox and Purex processes are listed in Tables I and II. These compilations represent the best estimate by technical personnel of the data required to attain the immediate goals of the in-line instrument program; namely, maximum operating efficiency, minimum waste losses, and positive process control when manual operation is employed[24,25]. These data will also furnish a basis for future automaton of the plants.

APPLICATION SCHEDULE

The application schedule given in Tables I and II is based on the availability of funds, anticipated availability of funds, plant requirements, and contemplated development progress. The fifteen instruments listed for plant installation on Fiscal Year 1956 funds are units sufficiently developed for immediate plant application, and are units needed for process control. The majority of the installations made on Fiscal Year 1956 funds will be in the Redox Plant since the Purex Plant already has twenty-two developed instruments installed or scheduled for installation. The thirty-six instruments listed for installation on Fiscal Year 1957 funds represents instruments now being developed and instruments now developed for which no samplers exist. The installations listed for Fiscal Year 1958 installation represent instruments now developed, instruments now being developed, and instruments being considered for development. Fulfillment of the plant requirements as now visualized should be completed on Fiscal Year 1958 funds.

FISCAL YEAR 1956 APPLICATION

In-line instrument application from anticipated funds for Fiscal Year 1956 were selected on the basis of (1) the points in the processes where in-line analyses are required and (2) the availability of instruments ready for plant use. The gamma scintillation monitor, alpha monitor, and uranium colorimeter are sufficiently developed for immediate application and will give valuable analytical data when installed on the streams designated in the 1956 Fiscal Year Proposal[21].

At Purex, the alpha monitors on the IAW and 2DW streams detect plutonium losses and give a measure of the behavior in the IA and 2D Columns, respectively. The uranium colorimeters on the IAF and 2DF feed streams give necessary data to achieve high decontamination and low waste losses in the IA and 2D Columns.

In the Redox Plant, the IAFS, 2DF, and 2AF gamma monitors measure the DF across the partition cycle, while the gamma monitors on the 2DF and the inlet to the silica gel bed measure the DF across the second uranium cycle. The 2BP (or 3AF) and 3BP gamma monitors measure the DF across the third plutonium cycle. The gamma monitors on the inlet and outlet of the silica gel bed, detect the zirconium-niobium removal across the silica gel bed. The F-0 alpha monitor provides a measure of the plutonium loss from the 2D, 2A, and 3A Columns and the HAIS alpha printer checks the plutonium loss from the IA Column. The IOW and L-9 alpha printers check the plutonium concentration on these streams. These instruments will provide analytical data, with a time delay of not more than fifteen minutes. Using conventional laboratory methods, these data can only be obtained once every two or three hours under "rush" conditions.

CONCLUSIONS

The in-line instrument research and development program will result in extensive application of in-line instruments in H.A.P.O. Separations Plants during Fiscal Years 1956, 1957, and 1958. These instruments will provide a degree of process control heretofore unattainable and will provide a basis for future automaton of the separations plants.

Head, Separations Equipment Development
Separations Technology Section
ENGINEERING DEPARTMENT

Separations Equipment Development
Separations Technology Section
ENGINEERING DEPARTMENT

/dgl

TABLE I

REQUIRED PUREX IN-LINE INSTRUMENTATION

Stream or Tank	To Be Determined	Possible Method	56	57	58
Reaction Gas	Iodine-131	Gamma Scintillation Spectrometer			X
Vent Gas	Iodine-131	Gamma Scintillation Spectrometer			X
HAF	U	Gamma absorptometer			X
	HNO_3	pH with dilution			X
	Pu valence	Redox potential/colorimeter			X
Recycle Solvent No. 1 Header	% TBP	Dielectric Constant			X
HAP	U	Colorimeter/gamma absorptometer		X	
	Gross gamma	Gamma scintillation (current type)		X	
	Entrainment	Turbidimeter ?			X
		Sampler required		X	
HAW	U	Polarograph		X	
	Pu	Extraction of Pu from Am-Cm and alpha count			X
HCW	Pu	Contact alpha counter			X
	U	Fluorimeter			X
	HNO_3	Dielectric constant			X
HCP	Entrainment	Turbidimeter			X
	Gross gamma	Gamma scintillation (current type)			X
	U	Colorimeter/gamma absorptometer			X
		Sampler required			X
HPC	U	Colorimeter/gamma absorptometer		X	
		Sampler required for boiling solution		X	
HPD	Gross gamma	Gamma scintillation (current type)	Installed		
	HNO_3	pH			X
IAF	U	Colorimeter	X		
	HNO_3	pH with dilution		X	
	Pu valence	Redox potential/colorimeter			X
IAP	Gross gamma	Gamma scintillation (current type)		X	
	U	Colorimeter		X	
	Entrainment	Turbidimeter			X
		Sampler required		X	
IAW	Pu	Alpha printer	X		
	U	Polarograph		X	
IBP	Gross gamma	Gamma scintillation (current type)	Installed		
	U	Fluorimeter			X
	$Fe(NH_2SO_3)_2$	Redox potential			X
IBU	Gross gamma	Gamma scintillation (current type)			X
	U	Colorimeter		X	
	Pu	Contact alpha counter			X
		Sampler required		X	
ICW	HNO_3	Dielectric constant			X
	Pu	Contact alpha counter			X
	U	Fluorimeter			X
ICU	Gross gamma	Gamma scintillation (current type)			X
	Entrainment	Turbidimeter			X
		Sampler required			X
IUC	U	Gamma absorptometer		X	
	HNO_3	pH with dilution			X
		Sampler required		X	
IUD	Gross gamma	Gamma scintillation (current type)	Installed		
	HNO_3	pH			X
2DF	Gross gamma	Gamma scintillation (current type)	Installed		
	U	Colorimeter	X		
	HNO_3	pH with dilution		X	
	Pu (if not on IBU)	Contact alpha counter			X
2DW	U	Polarograph		X	
	Pu	Alpha printer	X		
2DU	Gross gamma	Gamma scintillation (current type)		X	
	U	Colorimeter		X	
		Sampler required		X	
2DX	% TBP	Dielectric constant			X
2EW	HNO_3	Dielectric constant			X
	U	Fluorimeter			X
2EU Exit column	Specific gamma	Gamma scintillation spectrometer			X
	U	Colorimeter		X	
	HNO_3	pH with dilution		X	
		Sampler required		X	
2UD	Gross gamma	Gamma scintillation (current type)	Installed		
	HNO_3	pH			X
2EU (K-5 Tank Inlet to Silica Gel)	Gross gamma	Gamma scintillation (pulse type)	Installed		
	Specific gamma	Gamma scintillation spectrometer			X
	U	Colorimeter/gamma absorptometer			X
	HNO_3	pH with dilution			X
Silica Gel	Specific gamma (Zr-Nb)	Gamma scintillation spectrometer			X

TABLE II

REQUIRED REDOX IN-LINE INSTRUMENTATION

Stream or Tank	To Be Determined	Possible Method	56	57	58
Reaction Gas	Iodine-131	Gamma scintillation spectrometer			X
Oxidizer H-7	Acid deficiency	pH with dilution			X
	U	Gamma absorptometer			X
	Pu	Contact alpha counter			X
Recycle	HNO_3	pH with dilution			X
	Pu	Contact alpha counter			X
HAIS	U	Polarograph		X	
	Acid deficiency	pH with dilution		X	
	$Na_2Cr_2O_7$	Colorimeter/Redox potential		X	
	Pu	Alpha printer	X		
HAF H-1	Gross gamma	Gamma scintillation (current type)			X
	Acid deficiency	pH with dilution			X
	$Na_2Cr_2O_7$	Colorimeter/Redox potential			X
	Pu valence	Redox potential			X
HAW	U	Polarograph		X	
	Pu	Extraction of Pu from Am-Cm and alpha count			X
HAP	Gross gamma	Gamma scintillation (current type)			X
	Pu	Contact alpha counter			X
HCW	U	Fluorimeter			X
	Pu	Contact alpha counter			X
D-2 (Composite condensates)	Gross gamma	Gamma scintillation			X
IAFS	Gross gamma	Gamma scintillation (current type)	X		
	U	Gamma absorptometer		X	
	Acid deficiency	pH with dilution		X	
	$Na_2Cr_2O_7$	Colorimeter/Redox potential		X	
	Pu valence	Colorimeter/Redox			X
IAP	Gross gamma	Gamma scintillation (current type)			X
	Pu	Contact alpha counter			X
IBU	Gross gamma	Gamma scintillation (current type)			X
	Pu	Contact alpha counter			X
IBP	"	Fluorimeter			X
ICW	U	Fluorimeter			X
2DF	Gross gamma	Gamma scintillation (current type)	X		
	Acid deficiency	pH with dilution		X	
2DW	U	Polarograph (for the F-0 Tank)		X	
	Pu	Contact alpha counter			X
2DU	Gross gamma	Gamma scintillation (current type)			X
D-1 sump	Gross gamma	Gamma scintillation (current type)			X
	U	Polarograph			X
	Pu	Contact alpha counter			X
2EW	U	Fluorimeter			X
2EU Exit column	Gross gamma	Gamma scintillation (current type)			X
2EU Concentrate	Gross gamma	Gamma scintillation (pulse type)			X
	Pu	Contact alpha counter			X
Exit Ru Oxidizer	Gross gamma	Gamma scintillation (pulse type)	X		
Exit Silica Gel	Gross gamma	Gamma scintillation (pulse type)	X		
	U	Gamma absorptometer			X
Regeneration Waste	U	Fluorimeter/polarograph			X
Silica Gel Neutralizer	HNO_3	pH with dilution			X
2AF	Gross gamma	Gamma scintillation (current type)	X		
	HNO_3	pH with dilution		X	
	$Na_2Cr_2O_7$	Colorimeter		X	
	Pu	100 Kev gamma/contact alpha counter		X	
2AP	Gross gamma	Gamma scintillation (current type)			X
	Pu	100 Kev gamma/contact alpha counter			X
2AW	Pu	Contact alpha counter			X
2BW	Pu	Contact alpha counter			X
2BP	Gross gamma	Gamma scintillation (current type)	X		
	Pu	Gamma absorptometer		X	
3AF	HNO_3	pH with dilution		X	
3AP	Gross gamma	Gamma scintillation (current type)			X
3AW	Pu	Contact alpha counter			X
3BW	Pu	Contact alpha counter			X
3BP	Gross gamma	Gamma scintillation (current type)	X		
	HNO_3	pH with dilution		X	
	Pu	Gamma absorptometer		X	
F-0 Tank Combined waste	Pu	Alpha printer	X		
	U	Polarograph (see 2DW)		X	
Waste Concentrator	U	Polarograph			X
	Pu	Contact alpha counter			X
	Caustic factor	pH with neutralization			X
Neutralizer	pH	pH			X
IOW	U	Polarograph		X	
	Pu	Alpha printer	X		

REFERENCES

1. Connally, R. E., "Operation and Maintenance Instructions for Gamma Scintillation Monitor Model III", HW-29349, October 1, 1953 (Unclassified).

2. Koyama, K., Michelson, C. E. , and Alkire, G. J., "An Automatic Polarograph for the Determination of Uranium in Process Waste Streams", HW-30148, December 10, 1953 (Secret).

3. Leboeuf, M. B., Upson, U. L., and Connally, R. E., "A Continuous Gamma Activity Monitor for the Product Stream of the Uranium Recovery Plant", HW-29348, October 1, 1953 (Secret).

4. Michelson, C. E., "pH Monitoring of Metal Recovery Neutralized Waste", HW-33148, November 24, 1954 (Confidential).

5. Van Meter, W. P., Michelson, C. E., and Carson, W. N., "In-Line Analysis of Metal Recovery Process Feed", HW-29751, November 1, 1953 (Secret).

6. Leboeuf, M. B., Connally, R. E., Carson, W. N., "Proposal for Pilot Plant In-Line Instrumentation", February 3, 1954, (Confidential - Undocumented).

7. "Operations and Maintenance Manual In-Line Analytical Instruments of the Hot Semiworks", HW-34523, July 1955 (Official Use Only).

8. W. A. Burns, "In-Line Analytical Instrumentation for Separations Process Control at Hanford - An Interim Summary", HW-37624, March 31, 1955 (Secret).

9. Evans, T. F., "Hot Semiworks Summary, Run 1", HW-38768 RD, August 23, 1955, (Secret).

10. Evans, T. F., "Hot Semiworks Summary, Run 2", HW-38769 RD, August 23, 1955, (Secret).

11. Evans, T. F., "Hot Semiworks Summary, Run 3", HW-38770 RD, August 23, 1955, (Secret).

12. Nelson, J. W., Oberg, G. C., "Hot Semiworks Summary, Run 5", HW-39786 RD, November 2, 1955, (Secret).

13. Evans, T. F., Oberg, G. C., "Hot Semiworks Summary, Run 6", HW-39063 RD, September 20, 1955, (Secret).

14. Evans, T. F., Oberg, G. C., "Hot Semiworks Summary, Run 7", HW-39517 RD, October 17, 1955, (Secret).

15. Evans, T. F., Oberg, G. C., "Hot Semiworks Summary, Run 8", HW-39828 RD, November 4, 1955, (Secret).

DECLASSIFIED

16. Evans, T. F., Oberg, G. C., "Hot Semiworks, Run 9", HW-40281 RD, December 6, 1955, (Secret).

17. Hildreth, N. T., "In-Line Alpha Monitor Prototype Performance", HW-37272, October 11, 1955, (Secret).

18. Miller, D. G., "A Gamma Absorptometer for the Determination of Plutonium or Uranium", HW-36788, (Confidential).

19. Smith, R. E., "Iodine Monitor for Dissolver Off Gas", June 9, 1955, (Letter to W. M. Harty).

20. Smith, R. E., "Additional Purex Plant In-Line Instrumentation", June 15, 1955, (Letter to W. B. Webster).

21. Smith, A. E., "Proposed In-Line Instrument Installation Redox and Purex", HW-39822, November 4, 1955, (Official Use Only).

22. Smith, A. E., "Proposed In-Line Instrument Installations Redox, Purex, and "Z" Plants - Fiscal Year 1957", December 15, 1955, (Letter to E. L. Reed).

23. Alkire, G. J., "In-Line Analytical Methods and Instruments Requiring Research and Development", December 9, 1955, (Confidential - Undocumented).

24. Curtis, M. H., "Purex In-Line Monitors", November 30, 1955, (Letter to A. E. Smith).

25. Merrill, E. T., "In-Line Instrumentation for the Redox Plant", November 1, 1955, (Letter to G. J. Alkire).

DECLASSIFIED

[redacted]