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Separations Equipment Development Separations Technology Section ENGINEERING DEPARTMENT

December 30, 1955

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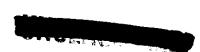
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THE APPLICATION OF IN-LINE INSTRUMENTS FOR SEPARATIONS PROCESS CONTROL FISCAL YEARS 1956, 1957, 1958

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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).

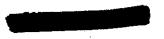
OBJECTIVE

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





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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-O 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

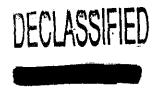
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		TABLE I	
		D PUREK IN-LIME INSTRUMENTATION	e/ == =0
Stream or Tank	To Be Determined	Possible Nethod	<u>56 57 58</u>
Reaction Gas	Iodine-131	Gamma Scintillation Spectrometer	X
Vent Gas	Iodine-131	Gamma Scintillation Spectrometer	X
Haf	U HNO ₃ Pu valence	Gamma absorptometer pH with dilution Redox potential/colorimeter	X X X
Recycle Solvent No. 1 Header	% TBP	Dielectric Constant	x
НАР	บ	Colorimeter/gamma absorptometer	x
	Gross gazma Entrainment	Gamma scintillation (current type) Turbidimeter ? Sampler required	x x
HAW	U Pu	Polarograph Extraction of Pu from Am-Cm and alpha count	x x
HCW	Pu U HNO3	Contact alpha counter Fluorimeter Dielectric constant	x x x
HCP	Entrainment	Turbidimeter	x
	Gross gamma U	Gamma scintillation (current type) Colorimeter/gamma absorptometer Sampler required	X X X
HPC	υ	Colorimeter/gamma absorptometer Sampler required for boiling solution	X X
HPD	Gross gamma ENO3	Gamma scintillation (current type) pH	Installed,
IAF	U HNO3 Pu Valence	Colorimeter pH with dilution Redox potential/colorimeter	x x x
IAP	Gross gamma	Gamma scintillation (current type)	x
	U Entrainment	Colorimeter Turbidimeter Sampler required	x x
IAW	Pu U	Alpha printer Polarograph	x x
IRP	Gross gamma U Fe(NH ₂ SO ₃) ₂	Gamma scintillation (current type) Fluorimeter Redox potential	Installed X X
180	Gross gamma	Gamma scintillation (current type)	x
	U Pu	Colorimeter Contact alpha counter Sampler required	x x
ICW .	HNO ₃ Pu U	Dielectric constant Contact alpha counter Fluorimeter	X X X
ICU	Gross gamma Entrainment	Gamma scintillation (current type) Turbidimeter Sampler required	X X X
ruc	u Hno ₃	Gamma absorptometer pH with dilution Sampler required	x x
מעד	Gross gamma HNO3	Gamma scintillation (current type)	Installed X
2DF	Gross gamma	Gamma scintillation (current type)	Installed
_	U HNO ₃ Pu (if not on IBU)	Colorimeter pH with dilution Contact alpha counter	x x
2DW	U Pu	Polarograph Alpha printer	x x
200	Gross gamma U	Gamma scintillation (current type) Colorimeter Sampler required	X X X
2DX	≸ TBP	Dielectric constant	X
SEM	ENO 3	Dielectric constant Fluorimeter	X X
2EU	Specific gamma	Gamma scintillation spectrometer	х
Exit column	т 1000 ₃	Colorimeter pH with dilution Sampler required	x x x
sm	Gross gamma HNO ₃	Gamma scintillation (current type) pH	Installed X
2EU (K-5 Tank Inlet to	Gross gamma Specific gamma U	Gamma scintillation (pulse type) Gamma scintillation spectrometer Colorimeter/gamma absorptometer	Installed X X
Silica Gel)	нио3	pH with dilution	x
Silica Gel	Specific gamma (Zr-Nb)	Gazzma scintillation spectrometer	х

TABLE II

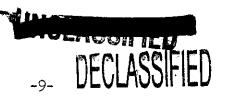
	****	TABLE II	
Stream or Tank	To Be Determined	URED REDOX IN-LINE INSTRUMENTATION Possible Method	56 57 58
Reaction Gas	Todine-131	Gemma scintillation spectrometer	х ,
Oxidizer H-7	Acid deficiency U Pu	pH with dilution Gamma absorptometer Contact alpha counter	x x x
Recycle	ENO3	pH with dilution Contact alpha counter	x x
HAIS	U Acid deficiency Na ₂ Cr ₂ O ₇ Pu	Polarograph pH with dilution Colorimeter/Redox potential Alpha printer	х х х
HAF H-1	Gross gamma Acid deficiency Na ₂ Cr ₂ O ₇ Pu valence	Gamma scintillation (current type) pH with dilution Colorimeter/Redox potential Redox potential	x x x x
HAW	U Pu	Polarograph Extraction of Pu from Am-Cm and alpha count	x x
НАР	Gross gamas Pu	Gamma scintiliation (current type) Contact alpha counter	X X
HCM	U Pu	Fluorimeter Contact alpha counter	X X
D-2 Composite condensates)	Gross gauma	Gemma scintillation	х
IAFS	Gross gamma U Acid deficiency Na ₂ Cr ₂ O ₇ Pu valence	Gamma scintillation (current type) Gamma absorptometer pH with dilution Colorimeter/Redox potential Colorimeter/Redox	x x x x
IVb	Gross gamas Pu	Ganma scintillation (current type) Contact alpha counter	х х
IBU	Gross gamma Pu	Gamma scintillation (current type) Contact alpha counter	X X
IBP	ŢĖ	Fluorimeter	x x
ICM	U Chone name	Fluorimeter Gamma scintillation (current type)	х х
2DF	Gross gamma Acid deficiency U	pH with dilution Polarograph (for the F-O Tank)	х х
2DW	Pu	Contact alpha counter	х
200	Cross gamma	Gamma scintillation (current type)	x
D-1 sump	Gross gamma U Pu	Gamma scintillation (current type) Polarograph Contact alpha counter	x x x
2EW	υ	Fluorimeter	x
2EU Exit column	Gross gauna	Gamma scintillation (current type)	X.
Concentrate	Gross gamma Pu	Gamma scintillation (pulse type) Contact alpha counter Gamma scintillation (pulse type)	x x
Exit Ru Oxidizer	Gross gamma		x
Exit Silica Gel	Gross gamma U	Gamma scintillation (pulse type) Gamma absorptometer	x
Regeneration Waste	v	Fluorimeter/polarograph	x
Silica Gel Neutralizer	имо ₃	pH with dilution	X
2AF	Gross gamme HNO ₃ Ne ₂ Cr ₂ O ₇ Pu	Gorms scintillation (current type) pH with dilution Colorimeter 100 Kev gamma/contact alpha counter	х х х
2AP	Gross gamma Pu	Gamma scintillation (current type) 100 Kev gamma/contact alpha counter	X X
2AW	Pu	Contact alpha counter	х
2BW	Pu	Contact alpha counter	X
2BP	Gross gamma Pu	Gamma scintillation (current type) Gamma absorptometer	x x
3AF	шю ₃	pH with dilution	x x
3AP	Gross gamma	Gamma scintillation (current type) Contact alpha counter	X
38W	Pu Pu	Contact alpha counter	x
3BP	Gross gamma. 1200-3	Gamma scintillation (current type) pH with dilution	X X X
F-0 Tank Combined waste	Pu " Pu V	Gamma absorptometer Alpha printer Polarograph (see 2D#)	x x
Waste Concentrator	U Pu Caustic factor	Polarograph Contact alpha counter pH with neutralization	x x x
Neutralizer	н	н	x
IOW	U Pu	Polarograph Alpha printer	x x

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