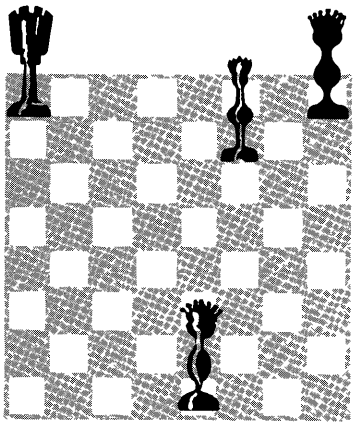
PROCESS COMPUTER SECTION

BOX 2918 • PHOENIX 2, ARIZONA

Number 27
January 26, 1966
Editor: D. E. Lauck

NEWSLETTER



OPERATION

CHECKMATE

In chess, the queen is the most powerful piece on the field of battle. This is why we at the Process Computer Business Section chose the king in checkmate as the symbol of our 1966 marketing objective.

General Electric is the most powerful player in the marketing battle for process computer orders. In 1966 we fully intend to checkmate King Competition. The key to Operation Checkmate is your hard-hitting selling efforts throughout 1966. By year end the specially trained process computer field sales force will have tripled its present size. Additional sales engineers will be moving into the field to increase customer coverage after completion of classes which begin in January, April, July and October.

Many new markets are becoming ripe for process computers. Among them are military and aerospace, food processing, medical, fibers, discrete product manufacturing and municipal services. Applications in these new markets are such functions as blend and batch control, automatic weighing, dispatching, sequence or supervisory control, production control and quality control testing. How many of your customers perform such operations in a planned or existing plant?

You have the power to attack and help perform the Checkmate. Though you may not have noticed, we have never referred to Operation Checkmate as a "game." If it is a game, then it is a deadly serious game. The queen is bound to checkmate the king...with your help.

RECENT ORDERS

GE/PAC 4020 for a slabbing mill

GE/PAC 4050 for on-line data collection (closed-loop later)

GE/PAC 4020 for alkylation, crude unit and reformer control

GE/PAC 4050 for scientific system

Two GE/PAC 4020's for turbine control

GE/PAC 4020 for cold rolling mill

GE/PAC 4020 for crude unit control

The attached Process Computer Business Section Marketing Directory will help you quickly get in touch with the appropriate sales unit after you have piqued customer interest in process computer systems. There are several brochures available to help you do this. "What's a process computer?" is available in two versions--electric utility or industrial. The industrial version is GEA-7260A. The electric utility version is GEA-8151. Both are available from Publication Distribution in Schenectady.

INDUSTRY CONTROL DEPARTMENT

GENERAL ELECTRIC

GE/PAC 4020 SPECIFICS

Interest is high in the new integrated circuit GE/PAC 4020 and here is more information for you to pass along to your customers.

Many systems on order, with several more immediate prospects. Delivery in 12 months, start programming anytime.

MULTIPLY SPEED: 12 microseconds maximum for a full 24-bit by 24-bit multiply.

DIVIDE SPEED: 13.6 microseconds maximum for a 24-bit quotient and 24-bit remainder.

INPUT/OUTPUT SPEED: 2 speeds selectable by program, 25 microseconds for communication with standard performance devices and 5 microsecond for high-speed input/output devices.

Fast! You bet, and with the regular GE/PAC instruction list and software, you're out in front of competition and we plan to keep you there. Here are two more advanced features you can tell your customers about to help bring in GE/PAC 4020 orders:

MEMORY PROTECT:

Carrying on the concept of "memory fencing" in the GE/PAC 4060, the GE/PAC 4020 will use an option called "QUADRITECT", a means of identifying each block of 64 words in memory by one of four states. In the protect mode, the hardware will trap any violation of the protect status by the program and prevent errors in a non-debugged program from "clobbering" a completely checked-out system program. The four states are identified by their associated tag of 2 core memory bits for a 64 word block, as follows:

TAG	STATE	USE
00	Illegal region	Checked out program
01	Read-only memory	Common Data Region
10	Read/Write Memory	Data Region for Running Program
11	Read/Write/Branch	Running Program

The operations of extracting the proper word from a table of protect status words in core memory and determining violations for trapping are completely carried out by the hardware. The Monitor Program assigns protect status and determines location of program bugs trapped by the hardware.

QUADRITECT is superior to the "two-state" memory protect of the IBM-1800, CD 1700, and H-20 computers which use an extra bit per word. This bit identifies read-only memory and read/write/branch memory. The four-state quadritect method protects against improperly addressed stores, reads, and branches, as well as normal program sequencing into a protected area. It also provides for protection against misoperation of input/output equipment. Primary advantage of QUADRITECT is its ability to confine a running program to its own program and data areas in memory and to completely isolate other defined areas from access by a running program. A further benefit is the ability within QUADRITECT to prevent a running program from locking out all program interrupts or from inhibiting interrupts for longer than a given time. This feature is an absolute must for protection on a real time process control system, but descriptions of competitive systems do not mention this capability.

INPUT/OUTPUT:

The 4020 has a unique hardware option which permits a system I/O device to communicate with a table in memory in a cycle-stealing type mode using an arithmetic unit channel. This allows the main program to function without concern for input/output operations during transfers of data in blocks up to 512 words in length. We call this the "MATCH" option meaning "Memory Automated Tabulation Channels" and the individual channels may be either "TIM" (Table Input to Memory) or "TOM" (Table Output from Memory).

Using the 4020's high-speed input/output timing, the system can use exceptionally high transfer speeds communicating with memory, independent of the accumulator (A) register but without the need for high cost peripheral controllers with their own timing and addressing. The arithmetic unit control is used during the I/O operations as the controller, and program is held up only long enough for each single TIM or TOM operation to take place as the device becomes ready and loads or stores the next word in the table.

"MATCH" is exclusive to GE/PAC 4020

This highly efficient command structure and the continued use of the 24-bit word for accuracy and ease of programming are features which give you a distinct advantage in CHECKMATING competition.

Photo above shows GE/PAC 4050 at left in the Systems Simulation Facility of SS & EO. in Schenectady. A six-page brochure, GEA-8208, tells the whole story to your customer. We suggest you order a few copies of this brochure from Publications Distribution to show your customers how General Electric is using its own products to benefit the buyer.

PROCESS COMPUTER SECTION

BOX 2918 • PHOENIX 2, ARIZONA

Number 28
February 23, 1966
Editor: D. E. Lauck

NEWSLETTER

3000 PROCESS COMPUTERS BY 1970!

This prediction comes from Midwest Research Institute, Kansas City, Mo. In dollar figures the annual market should be worth $1 billion by 1970. According to MRI, there will be a big upswing in the percentage of money spent for peripherals. The percentage now is 35--40 and it will increase to 65--70 by the end of the decade.

MRI picks steel, chemicals, petroleum, petrochemical, cement, pulp & paper, food processing, warehousing, railroads, electric power generation, rubber and plastics as key users of process computers to increase the productivity of their process lines.

Further, MRI predicts a whopping 10,000 process computers by 1975. Since there is no such thing as an "average" process computer system, either by configuration or price, we won't attempt to say how many dollars that might be. The point is, however, that there is a real booming market for process control computers. Carrying the point a little further, how much longer do you want to stand on the outside and look in? Process computers are here to stay. It's a pretty well-known fact that you can't sell something if you don't know anything about it. We suggest you start by reading GEA-7260A, "What's a process computer?" (industrial) or GEA-8151, "What's a process computer?" (electric utility). After you read it and have thought about who your first prospect is, contact one of the process computer specialists (they're all sales engineers) listed below:

D. E. W. (Dominic) Archdale, San Francisco
R. T. (Tom) Blakley, Los Angeles
R. P. (Dick) Carroll, Chicago
A. C. (Art) Cook, Cleveland
Frank Gorman, Philadelphia
W. C. (Bill) Gresham, Atlanta
A. E. (Aaron) Holland, Houston
F. L. (Frank) Judy, New York
R. J. (Bob) Nelson, New York
G. F. (Gordon) Osterhaus, Chicago
J. G. (John) Singer, San Francisco
W. M. (Bill) Vaughn, Houston
J. H. (John) Warren, Cleveland
C. E. (Cal) Watson, Houston

He'll be glad to help you get a story together for your customer.

* * *

All future orders for GE/PAC 4050 process computers will be booked as GE/PAC 4050-II. The GE/PAC 4050-II, known as the Mod II, will be 57% faster for memory addressing instructions, namely 3.2 microseconds. The 4050's presently on order will be delivered with the 5 microsecond cycle time but you can now quote 3.2 for future orders of the 4050. Instruction times listed on page four.

COMPUTERIZED FREIGHT-HANDLING SYSTEMS PREDICTED IN NEAR FUTURE

"In the next five years, we look for gains in palletized shipping by truck and rail to customer warehouses and plants, and greater use of computers for processing and inventory control." This statement comes from one of 250 respondents of a survey asking about trends in shipping methods. Most of the other replies had similar comments. From our point of view, the key words are "greater use of computers for processing and inventory control."

The GE/PAC 4040 at the Sunray DX tank truck terminal in Tulsa, Okla., is a prime example of what can be done with a computer in this area of application. The GE/PAC 4040 at Tulsa monitors the dispensing of several products while assuring that all safety requirements have been met by the driver before any material flows into his tank truck. By the time the driver reaches the gate of the terminal, a computer-produced bill of lading is waiting for him. Reformatted information is punched out on paper tape which is used by an off-line computer to perform billing and accounting work.

The Tulsa application is just one of many possible applications for GE/PAC's in the shipping and handling industry. How many can you think of...and sell?

HOT NEWS

GE/PAC 4020

See pages 3 & 4

PAPER MARKET POTENTIAL IS EXCELLENT

Another survey substantiates the fact that the pulp and paper industry is studying application of process computers to their process lines. A great deal of secrecy surrounds most of the investigative work in this industry but management realizes they will have to institute use of process computers to remain competitive.

Great Southern Land has indicated they will extend computer control (a GE-412) to a second linerboard machine.

However, the fact that there are more than 30 process computers either on line or on order is no secret. So you see, the pulp and paper industry is beyond the "just looking, thank you " stage. The market in this industry is in the magnitude of 250 or more process computer systems at the moment. And with increased demand for paper products, new plants will be needed.

As the wrap-up statement of the survey puts it-- "Today the question is: can I afford a computer? Tomorrow the question may be: can I afford to be without a computer?"

INDUSTRY CONTROL DEPARTMENT
GENERAL ELECTRIC

GE/PAC PRIMER

Everytime you take a shower, you are a process computer.

You sense with one hand, the signals go up your arm to your brain, you compute, running through your memory to determine how hot you like your shower, and then your process control arm adjusts the water to fit your particular shower program.

When you take a shower, you put one hand under the faucet to test the temperature of the water, ZAP... your hand is a thermocouple. The signals from the sensor, the thermocouple at the end of your arm, go up to the central processor, computer (your brain). If the water is much too hot, your MONITOR program calls an automatic priority interrupt and you yank your hand out before you get burned. Your MONITOR program has called up a functional program from memory and told you to get your hand out of there. Like the computer, you have decided a specified set of conditions is out of limits. Your other hand adjusts the faucets and you stick your hand back in again. If it was 10 seconds between the time you yanked your hand out and put it back in, your scan interval is 10 seconds.

The hand which worked the faucet is the process control device. But without the sensor, (your other hand) and the central processor, (your brain, i.e., the ability to reason, to make a judgment based on experience) you would not have a closed-loop process control system. If you pulled your hand out and went howling to the medicine cabinet for the burn ointment yelling "Ouch, Ouch!" or something more profane, you would be a data logger outputting man communication. If, in pain, you slam your fist into the wall and make several dents in the wall, you are imitating a data communications device such as a card punch. Most people wouldn't understand the significance of those dents but if another person does the same thing and turns to the wall to communicate, then that person, another central processor, will understand your captured data as displayed on or rather in the wall.

But let's go back to the original situation. The water was not hot enough to burn you, just a little too hot for your operating program. You change the set point until your central processor (your brain) says "Turn on Program Number Two." Program Number Two is a contact closure, you twist the handle and the water comes out of the showerhead instead of the faucet.

At this point you have "brought up the system" and you are ready to process. Your central processor is also capable of handling other functions such as scheduling and tracking. Your shower program schedule would be written in Tabular Sequence Control (TASC), and might read something like this...step into shower--close shower curtain--adjust shower head--pick up soap --etc. Since taking a shower is a relatively simple process, your central processor has a certain amount of "free time". This free time may be programmed to perform other functions such as singing Home On The Range or whatever your favorite shower song might be.

* * *

In our next NEWSLETTER we'll take up the slicing of time into milliseconds and microseconds, relating it to something a little more familiar...the speed of a bullet; to illustrate how fantastically speedy the GE/PAC computers are.

In subsequent NEWSLETTERs we'll be discussing punched tape vs. punched cards, magnetic drum vs. magnetic disc, and the need for parity check.

Suggestions for future GE/PAC PRIMER columns would be appreciated. What would you like to know about process computers? Drop the editor a line at P. O. Box 2918, Phoenix, Arizona.

CHECKMATE

the COMPETITION

RECENT ORDERS

GE/PAC 4050 for plant management system (refinery)

GE/PAC 4040 for lube and oil production unit control

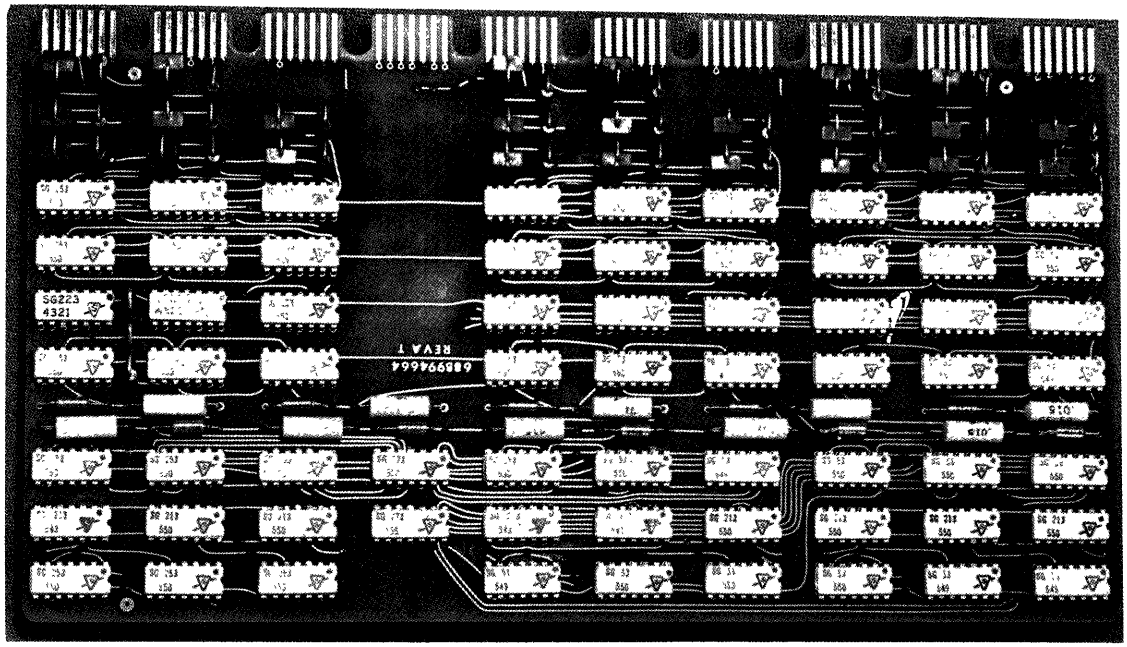
GE/PAC 4050 for control of nuclear power plant

GE/PAC 4050 for plastics manufacturing control

GE/PAC 4020 for control of a hydro-cracker

GE/PAC 4040 for scientific studies

FOUR GE/PAC 4040's for nuclear power station control



The GE/PAC 4020 will use the new GEAPS* design circuit logic modules. The epoxy glass boards eliminate warping and moisture problems and are modular from two to 10 inches in one-inch increments. This modularity permits use of small boards to implement minor options.

The circuit family chosen provides numerous advantages such as voltages compatible with present GE/PAC, ground reference, high noise rejection through three volts logic swing and high temperature capability to meet 55 C external ambient. The efficient logic structure reduces component count and higher reliability is obtained through the reduced number of interconnections of the monolithic circuit elements. Additional benefits are lower power and space requirements.

The connectors are located along the 10-inch edge of the board and are grouped to bus to the individual one-inch connectors mounted on the back panel.

General Electric Advanced Packaging System

YOUR GREASE PENCIL CAN HELP YOU SELL

The attached ads can be a powerful visual aid when properly used. And the only tools you need to do the job are a grease pencil, a sharp selling mind and the reprint itself. Use the grease pencil to underline key items you want that particular prospect to note and remember. The benefits are almost always general in nature. Of course the benefits come from the features and you will want to emphasize certain features and play down others. Following the features you will probably find supporting data and the copy of the ad will end with a call for action. You don't need all of the copy in the ad. The ad is designed to influence, persuade, sell, or whatever you want to call it, all by itself. You, as a person, are more powerful than any advertisement and you don't need all those words in the ad to do your job, that's why you're there. So use that grease pencil to underline or circle only those points which you think are important to that particular prospect. Then, wherever there is space, maybe even right across the illustration, print the important benefits, actually write your own headline for the ad. Keep these lines short and sharp.

Our authority on marked-up ads says--don't walk in, pull out the ad and start talking. Set the stage first. Use the ad as a visual aid once you have set the stage and led into the benefits...where the introduction of the marked-up ad flows naturally into the presentation. And don't, for heaven's sake, read the ad to your prospect. Whether it's a reprint or a preprint, you're not conducting a third grade reading class. Don't insult the man's intelligence. If he wants to read it word for word, he can do that after you leave.

Try it. Pick either a food processing plant or a textile mill and mark up the attached ad. After you make your call, drop me a line and tell me how the system worked. In the same letter I hope you'll be requesting additional copies of our ad reprints to use as individualized visual aids for your other customers and prospects.

WHAT THE COMPETITION IS UP TO...

IBM Corp. has obtained a license under patents covering a production line system manufactured by the Cargill-Detroit Corp. Under this license, IBM plans to manufacture and market the Cargill system. More than 80 of these mechanical systems have been installed to date for various industrial companies, primarily for assembly functions. According to IBM, the system can accomodate temporary delays without interrupting production. Parts are conveyed along the production line on special pallets past a succession of work stations, at which either manual or automatic operations are performed. The pallets are designed to queue up at work stations during typical interruptions, such as those for tool replacement, inspection, malfunction, or manual time variations. In effect, the system can create a protective "float" of work in process between stations. It is this "float" which contributes to the optimum efficiency of the production line at all times, IBM said.

* * *

The Foxboro Company has sold its first digital computer system in Europe to Chemische Werke Huels, Marl, West Germany. The two systems (contract totaling over $500,000) will control both continuous and batch processing in a large chemical complex near Dusseldorf.

Chase Brass & Copper Company's $8 million plant in Montpelier, O., will be controlled by a Foxboro M97600. The plant will produce free-cutting brass rods using brass chips as the basic raw material. From the automatic dumping of truckloads of incoming metal chips and turnings, the entire plant is controlled and sequenced by the on-line process control computer.

Symbolic Code	Name	4020 1.6 μs	4050-II 3.2 μs
ABL	APPEND.ITEM TO BEGINNING OF LIST	*125.6	15.7
ACT	ACTIVATE DEVICE D	26.5	31.4
		8.5	
ADD	ADD	3.2	6.4
ADO	ADD ONE TO BIT K	4.8	14.1
AEL	APPEND.ITEM TO END OF LIST	*125.6	15.7
AFA	ADD FIELD TO A	N/A	14.1
AKA	ADD K TO A	*6.4	3.2
ANA	AND TO A	3.2	6.4
BRU	BRANCH UNCONDITIONALLY	3.2	3.2
BTR	BRANCH IF TSTF RESET	3.2	3.2
BTS	BRANCH IF TSTF SET	3.2	3.2
CBK	CHANGE BIT	4.8	14.1
CLO	COUNT LEAST SIGNIFICANT ONES	4.8	14.1
CLZ	COUNT LEAST SIGNIFICANT ZEROS	4.8	14.1
CMO	COUNT MOST SIGNIFICANT ONES	4.8	14.1
CMZ	COUNT MOST SIGNIFICANT ZEROS	4.8	14.1
CPL	COMPLEMENT A	4.8	14.1
DAD	DOUBLE ADD	*51.2	9.6
DLA	(SHIFT) DOUBLE LEFT ARITHMETIC	8.0	14.1
DLD	DOUBLE LENGTH LOAD	*27.2	9.6
DLL	(SHIFT) DOUBLE LEFT LOGICAL	8.0	14.1
DMT	DECREMENT MEMORY AND TEST	4.8	9.6
DRA	(SHIFT) DOUBLE RIGHT ARITHMETIC	8.0	14.1
DRC	(SHIFT) DOUBLE RIGHT CIRCULAR	8.0	14.1
DRL	(SHIFT) DOUBLE RIGHT LOGICAL	8.0	14.1
DST	DOUBLE LENGTH STORE	*32.0	9.6
DSU	DOUBLE SUBTRACT	*60.8	9.6
DVD	DIVIDE	max. of 13.7	29.1
ERA	EXCLUSIVE OR TO A	3.2	6.4
FAD	FLOATING ADD	*243.2	*152.00
FDV	FLOATING DIVIDE	*237.7	*220.00
FIX	FIX FLOATING NUMBER	*152.0	*215.
FLO	FLOAT FIXED NUMBER	*163.2	*175.
FMP	FLOATING MULTIPLY	*198.8	*178.00
FSU	FLOATING SUBTRACT	*251.2	*165.00
IAI	INHIBIT AUTOMATIC INTERRUPT	3.2	6.4
IBK	ISOLATE BIT K	4.8	14.1
IDL	INPUT FROM DEVICE TO LIST	N/A	48.3
IN	INPUT FROM DEVICE D	26.5	31.4
		8.5	
INX	INCREMENT X	4.8	9.6
JND	JUMP IF NO DEMAND	3.2	6.4
JNE	JUMP IF DEVICE D NOT IN ERROR	26.5	31.4
		8.5	
JNO	JUMP IF NO OVERFLOW	3.2	6.4
JNP	JUMP IF NO PARITY ERROR	3.2	6.4
JNR	JUMP IF DEVICE D NOT READY	26.5	31.4
		8.5	
LBM	LOAD BIT MASK	4.8	14.1
LDA	LOAD THE A REGISTER	3.2	6.4
LDB	LOAD HIGH SPEED I/O BUFFER	N/A	6.4
LDF	LOAD FIELD	N/A	14.1
LDI	LOAD INDIRECT	*36.8	9.6
LDK	LOAD A WITH K	*6.4	3.2
LDO	LOAD ONE INTO BIT K	4.8	14.1
LDP	LOAD PLACE	3.2	6.4
LDQ	LOAD THE Q REGISTER	*28.8	6.4
LDR	LOAD REGISTER	N/A	48.0
LDX	LOAD X WORD	4.8	9.6
LDZ	LOAD ZEROS INTO A	4.8	14.1
LMO	LOAD MINUS ONE	4.8	14.1
LPR	LOAD PLACE AND RESTORE	3.2	6.4
LXC	LOAD X WITH COUNT	4.8	9.6
LXK	LOAD X WITH K	4.8	9.6

Symbolic Code	Name	4020 1.6 μs	4050-II 3.2 μs
MAQ	MOVE A TO Q	8.0	14.1
MPY	MULTIPLY	8.9-12.1	18.2 avg.
NEG	NEGATE	4.8	14.1
NOP	NO OPERATION	4.8	9.6
ODL	OUTPUT TO DEVICE FROM LIST	N/A	48.3
OOM	OPERATE ON MEMORY	*59.2	9.6
OPR	OPERATE DEVICE D	26.5	31.4
		8.5	
ORA	OR TO A	3.2	6.4
OUT	OUTPUT TO DEVICE D	26.5	31.4
		8.5	
PAI	PERMIT AUTOMATIC INTERRUPT	3.2	6.4
RBK	RESET BIT K	4.8	14.1
RBL	REMOVE BEGINNING ITEM FROM LIST	*127.2	15.7
RCS	READ CONSOLE SWITCHES	3.2	6.4
REL	REMOVE ENDING ITEM FROM LIST	*140.0	15.7
REV	RESET TSTF IF BIT K IS EVEN	4.8	14.1
RNZ	RESET TSTF IF A IS NONZERO	4.8	14.1
ROD	RESET TSTF IF BIT K IS ODD	4.8	14.1
RPT	REPEAT	N/A	16.0
RST	RESET TSTF	4.8	14.1
SBK	SET BIT K	4.8	14.1
SEL	SELECT DEVICE D	26.5	31.4
		8.5	
SET	SET TSTF	4.8	14.1
SEV	SET TSTF IF BIT K IS EVEN	4.8	14.1
SFA	SUBTRACT FIELD FROM A	N/A	14.1
SKA	SUBTRACT K FROM A	*6.4	3.2
SLA	SHIFT LEFT ARITHMETIC	8.0	14.1
SLL	SHIFT LEFT LOGICAL	8.0	14.1
SNZ	SET TSTF IF A IS NONZERO	4.8	14.1
SOD	SET TSTF IF BIT K IS ODD	4.8	14.1
SPB	SAVE PLACE AND BRANCH	3.2	6.4
SRA	SHIFT RIGHT ARITHMETIC	4.8	14.1
SRC	SHIFT RIGHT CIRCULAR	4.8	14.1
SRL	SHIFT RIGHT LOGICAL	4.8	14.1
SSA	SET STALL ALARM	3.2	6.4
STA	STORE CONTENTS OF A	3.2	6.4
STB	STORE HIGHSPEED I/O BUFFER	N/A	6.4
STF	STORE FIELD	N/A	14.1
STI	STORE INDIRECT	*43.2	9.6
STQ	STORE CONTENTS OF Q	*28.8	6.4
STR	STORE REGISTERS	N/A	48.0
STX	STORE X	4.8	9.6
SUB	SUBTRACT	3.2	6.4
TER	TEST EVEN AND RESET BIT K	4.8	14.1
TES	TEST EVEN AND SET BIT K	4.8	14.1
TEV	TEST BIT K EVEN	4.8	14.1
TFE	TEST FIELD EQUAL	N/A	14.1
TFL	TEST FIELD LESS	N/A	14.1
TNM	TEST NOT MINUS ONE	4.8	14.1
TNZ	TEST A NONZERO	4.8	14.1
TOD	TEST BIT K ODD	4.8	14.1
TOR	TEST ODD AND RESET BIT K	4.8	14.1
TOS	TEST ODD AND SET BIT K	4.8	14.1
TSC	TEST AND SHIFT CIRCULAR	4.8	14.1
TXH	TEST X HIGH OR EQUAL	4.8	6.4
TZC	TEST ZERO AND COMPLEMENT	4.8	14.1
TZE	TEST A ZERO	4.8	14.1
XEC	EXECUTE	3.2	3.2
TIM/TOM	TABLE I/O	11.7 & 29.7	N/A
		11.7	

*Extended function of "quasi" instruction
Index Address Modification Adds one word time to stated execution times.

Note: Where two times are listed for one instruction the smaller figure is for the high-speed I/O channel of the GE/PAC 4020.

- Range and dye beck processing
- Weaveroom production accounting and malfunction analysis
- Chemical recovery systems
- Color control for synthetic fibers
- Tensile testing and analysis
- Production scheduling...

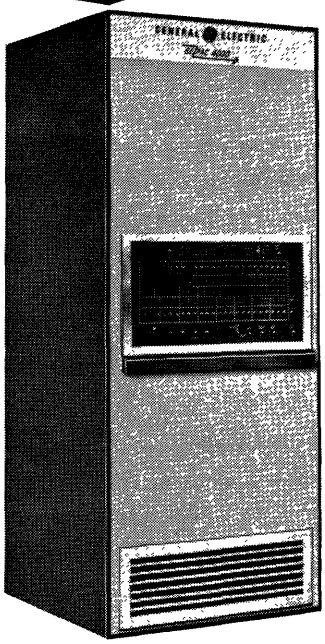
ALL CONTROLLED WITH GE/PAC*4000

What are you doing about meeting the challenge of greater textile demand . . . the need for increased productivity . . . improved quality . . . the impact of new technology on your profitability curve? GE/PAC 4000 computers in control of your process, from picking to finishing, can increase production as much as 30% with more consistent quality.

The versatility, reliability and economy of GE/PAC computers make on-line process control in your mill a money-saving "must." You get more for your invested dollar in control of becks and ranges as well as production monitoring and scheduling on looms, spinning frames, pickers and slashers. GE/PAC is your best automation buy with integrated circuits, 1.6 microsecond speed, compatible off-the-shelf software and 24-bit word length.

General Electric—a skilled hand in textile process automation—will be pleased to show you other GE/PAC features and how they can increase your profits "in the process"! *Contact your nearest General Electric Apparatus Sales Office or the Process Computer Section, P.O. Box 2918, Phoenix, Arizona 85002.*

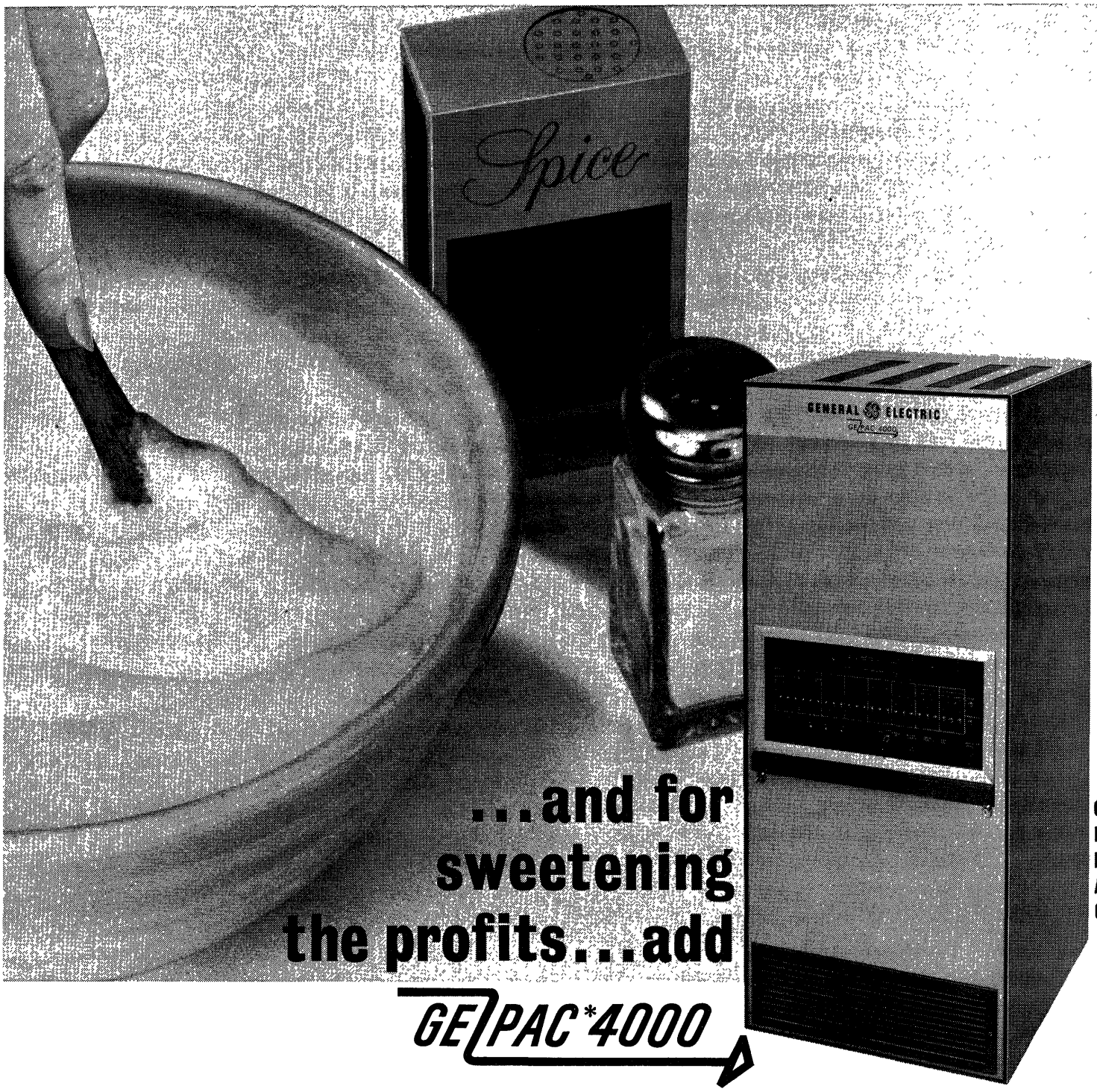
PCA 069-30



General Electric Process Automation Computer

*Trademark General Electric Co.

GENERAL ELECTRIC



...and for sweetening the profits...add GE/PAC*4000

General Electric Process Automation Computer

The GE/PAC way to more profitable food processing is through higher volume at lower cost while meeting consistent taste and quality standards. GE/PAC helps you to know your process better—cuts down on process failures... establishes tolerance levels... prevents off-grade product... eliminates judgment errors in your ingredient mix—enabling you to keep pace with consumers' rising standards of food excellence.

GE/PAC 4000 computers are feature-packed to give you more for your control dollar. Off-the-shelf GE/PAC software and the 24-bit word length brings you earlier return on your automation investment and lower programming costs. Integrated circuits assure highest performance, reliability and compactness. Control of your entire plant is now practical with GE/PAC's 1.6 microsecond speed and exclusive Free-time system which make possible the performance of off-line duties (generating quality control reports, timely yield information, inventory control, comparative laboratory data handling, and real-time scheduling of material handling and shipping) at the same time it is controlling one or more processes.

General Electric's food processing control specialists will be pleased to show you other GE/PAC features and how they can sweeten your profits "in the process." *Contact your nearest General Electric Apparatus Sales Office or the Process Computer Section, P. O. Box 2918, Phoenix, Arizona 85002.*

*Trademark General Electric Co.

PCA 069-29

GENERAL ELECTRIC

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 29
March 30, 1966
D. E. Lauck, Editor

NEWSLETTER

Announcing... GE/PAC **FORTY FIFTY - II**

GENERAL ELECTRIC TOES THE BART MARK

General Electric and three other contractors are vying for the vendor slot at the Bay Area Rapid Transit test site near San Francisco. Getting this plum will put the winner in a favorable light to play the supplier role in several other rapid transit systems being planned around the country. One morning last month the members of the BART Board of Control assembled at the test site for demonstrations by all four contenders.

During the demonstrations, Competitor A damaged sensing equipment on one car when it ran into a sandpile at the end of the tracks---with the Board in the car! Competitor B had trouble getting their car moving and once stopped on a curve for no apparent reason. Competitor C had only one problem---they couldn't get their car to stop at the stations. Before the station---yes. Past the station---yes. At the station---sometimes...but when they miss, it makes a mighty long first step for Charlie the Commuter after a hard day at the office.

"The General Electric demonstration," said Bill Morgan, Product Service Engineer, "was a marvel of success."

"It went without a hitch and the accuracy of the station stops was almost unbelievable. Car 'A' stopped at Oak Grove to pick up the dignitaries and it stopped exactly on the mark---with all 15 of them standing there on the platform. The doors flew open and just as the last of them got aboard, the doors slammed shut and the car moved out. This was typical of every stop. After the demonstration, the BART Test Director mentioned to the Board that G.E. was the only contractor to demonstrate without one problem."

A lot of General Electric talent, experience and equipment went into this successful demonstration. An important part of it was the GE/PAC 4040 process computer which made thousands of calculations and comparisons each second about the operation of rapid transit cars travelling at 80 miles per hour.

Granted you may not have a lot of chances to sell a GE/PAC 4000 computer to control a rapid transit system, but then maybe there's a railroad classification yard in your area like the one at the Alton & Southern yard in East St. Louis, Mo. It's controlled by a GE/PAC 4040, you know.

If you can't find a railroad classification yard, try a steel mill (we're big on those), chemical plant, petroleum refinery, paper or cement mill, food processing plant, textile mill, or discrete product manufacturer. In fact, any kind of volume batch process or line process operation is an ideal target for a process computer sale. How many can you think of in your territory?

The GE/PAC family has grown once more. The new face is the GE/PAC 4050-II, spoken Forty Fifty Mod II. It is completely program compatible with the 4050-I and the 4060. The 4050-II provides the same advanced capabilities as these other team members, including:

REPEAT
CIRCULAR LIST PROCESSING
EVERY WORD IN MEMORY AN ACCUMULATOR
FIELD ARITHMETIC
INPUT/OUTPUT FROM LIST
HARDWARE ASSISTED FLOATING POINT SUBROUTINES
OPTIONAL HARDWARE FLOATING POINT UNIT
CORE MEMORY TO 64,000 WORDS WITH OVERLAP
FULL GE/PAC LINE OF SYSTEM EQUIPMENTS
MASKED MEMORY SEARCH CAPABILITY

With a core cycle time of 3.2 microseconds, the 4050-II covers those applications where Programming power is needed, together with high speed. Memory addressing instructions operate 57% faster than on the 4050-I. Remember, the GE/PAC 4050-II is available for delivery in 1966. When even more speed is needed, the GE/PAC 4060 will handle the toughest jobs.

Execution times for the GE/PAC 4050-II are listed on the back of this NEWSLETTER.

PROGRAMMED INSTRUCTION TO BE PREREQUISITE FOR PHOENIX CLASSES

Product Service Training Courses 04, 05 and 07 have a new prerequisite. To insure that students are more equally knowledgeable when they arrive in Phoenix for training, a programmed learning course has been prepared. Each prospective student (G.E. or customer personnel) must successfully complete a written test based on the material in the programmed instruction course.

Anyone planning to send students to Phoenix for Product Service training should notify the registrar, W. D. Trudgen, Mgr.-Application Engineering, at least a month prior to their arrival in Phoenix. The programmed learning material will then be sent to the student so he can work the course and pass the test prior to attending the class in Phoenix.

The first courses to which the prerequisites apply are the 05 class starting May 30, 1966 and all 04, 05 and 07 classes starting after May 30, 1966.

COMPETITIVE BITS...

IBM still refuses to offer availability runs on steam power plant quotes they are making. We offer availability runs only when they are specifically requested as part of the quote by the customer. However, this does give you a stronger position when the subject of availability runs are part of negotiations for a sale.

FORTY FIFTY - II

Symbolic Code	Name	4050-II 3.2 μs
ABL	APPEND.ITEM TO BEGINNING OF LIST	15.7
ACT	ACTIVATE DEVICE D	31.4
ADD	ADD	6.4
ADO	ADD ONE TO BIT K	14.1
AEL	APPEND.ITEM TO END OF LIST	15.7
AFA	ADD FIELD TO A	14.1
AKA	ADD K TO A	3.2
ANA	AND TO A	6.4
BRU	BRANCH UNCONDITIONALLY	3.2
BTR	BRANCH IF TSTF RESET	3.2
BTS	BRANCH IF TSTF SET	3.2
CBK	CHANGE BIT	14.1
CLO	COUNT LEAST SIGNIFICANT ONES	14.1
CLZ	COUNT LEAST SIGNIFICANT ZEROS	14.1
CMO	COUNT MOST SIGNIFICANT ONES	14.1
CMZ	COUNT MOST SIGNIFICANT ZEROS	14.1
CPL	COMPLEMENT A	14.1
DAD	DOUBLE ADD	9.6
DLA	(SHIFT) DOUBLE LEFT ARITHMETIC	14.1
DLD	DOUBLE LENGTH LOAD	9.6
DLL	(SHIFT) DOUBLE LEFT LOGICAL	14.1
DMT	DECREMENT MEMORY AND TEST	9.6
DRA	(SHIFT) DOUBLE RIGHT ARITHMETIC	14.1
DRC	(SHIFT) DOUBLE RIGHT CIRCULAR	14.1
DRL	(SHIFT) DOUBLE RIGHT LOGICAL	14.1
DST	DOUBLE LENGTH STORE	9.6
DSU	DOUBLE SUBTRACT	9.6
DVD	DIVIDE	29.1
ERA	EXCLUSIVE OR TO A	6.4
FAD	FLOATING ADD	*152.00
FDV	FLOATING DIVIDE	*220.00
FIX	FIX FLOATING NUMBER	*215.
FLO	FLOAT FIXED NUMBER	*175.
FMP	FLOATING MULTIPLY	*178.00
FSU	FLOATING SUBTRACT	*165.00
IAI	INHIBIT AUTOMATIC INTERRUPT	6.4
IBK	ISOLATE BIT K	14.1
IDL	INPUT FROM DEVICE TO LIST	48.3
IN	INPUT FROM DEVICE D	31.4
INX	INCREMENT X	9.6
JND	JUMP IF NO DEMAND	6.4
JNE	JUMP IF DEVICE D NOT IN ERROR	31.4
JNO	JUMP IF NO OVERFLOW	6.4
JNP	JUMP IF NO PARITY ERROR	6.4
JNR	JUMP IF DEVICE D NOT READY	31.4
LBM	LOAD BIT MASK	14.1
LDA	LOAD THE A REGISTER	6.4
LDB	LOAD HIGH SPEED I/O BUFFER	6.4
LDF	LOAD FIELD	14.1
LDI	LOAD INDIRECT	9.6
LDK	LOAD A WITH K	3.2
LDO	LOAD ONE INTO BIT K	14.1
LDP	LOAD PLACE	6.4
LDQ	LOAD THE Q REGISTER	6.4
LDR	LOAD REGISTER	48.0
LDX	LOAD X WORD	9.6
LDZ	LOAD ZEROS INTO A	14.1
LMO	LOAD MINUS ONE	14.1
LPR	LOAD PLACE AND RESTORE	6.4
LXC	LOAD X WITH COUNT	9.6
LXK	LOAD X WITH K	9.6

Symbolic Code	Name	4050-II 3.2 μs
MAQ	MOVE A TO Q	14.1
MPY	MULTIPLY	18.2 avg.
NEG	NEGATE	14.1
NOP	NO OPERATION	9.6
ODL	OUTPUT TO DEVICE FROM LIST	48.3
OOM	OPERATE ON MEMORY	9.6
OPR	OPERATE DEVICE D	31.4
ORA	OR TO A	6.4
OUT	OUTPUT TO DEVICE D	31.4
PAI	PERMIT AUTOMATIC INTERRUPT	6.4
RBK	RESET BIT K	14.1
RBL	REMOVE BEGINNING ITEM FROM LIST	15.7
RCS	READ CONSOLE SWITCHES	6.4
REL	REMOVE ENDING ITEM FROM LIST	15.7
REV	RESET TSTF IF BIT K IS EVEN	14.1
RNZ	RESET TSTF IF A IS NONZERO	14.1
ROD	RESET TSTF IF BIT K IS ODD	14.1
RPT	REPEAT	16.0
RST	RESET TSTF	14.1
SBK	SET BIT K	14.1
SEL	SELECT DEVICE D	31.4
SET	SET TSTF	14.1
SEV	SET TSTF IF BIT K IS EVEN	14.1
SFA	SUBTRACT FIELD FROM A	14.1
SKA	SUBTRACT K FROM A	3.2
SLA	SHIFT LEFT ARITHMETIC	14.1
SLL	SHIFT LEFT LOGICAL	14.1
SNZ	SET TSTF IF A IS NONZERO	14.1
SOD	SET TSTF IF BIT K IS ODD	14.1
SPB	SAVE PLACE AND BRANCH	6.4
SRA	SHIFT RIGHT ARITHMETIC	14.1
SRC	SHIFT RIGHT CIRCULAR	14.1
SRL	SHIFT RIGHT LOGICAL	14.1
SSA	SET STALL ALARM	6.4
STA	STORE CONTENTS OF A	6.4
STB	STORE HIGHSPEED I/O BUFFER	6.4
STF	STORE FIELD	14.1
STI	STORE INDIRECT	9.6
STQ	STORE CONTENTS OF Q	6.4
STR	STORE REGISTERS	48.0
STX	STORE X	9.6
SUB	SUBTRACT	6.4
TER	TEST EVEN AND RESET BIT K	14.1
TES	TEST EVEN AND SET BIT K	14.1
TEV	TEST BIT K EVEN	14.1
TFE	TEST FIELD EQUAL	14.1
TFL	TEST FIELD LESS	14.1
TNM	TEST NOT MINUS ONE	14.1
TNZ	TEST A NONZERO	14.1
TOD	TEST BIT K ODD	14.1
TOR	TEST ODD AND RESET BIT K	14.1
TOS	TEST ODD AND SET BIT K	14.1
TSC	TEST AND SHIFT CIRCULAR	14.1
TXH	TEST X HIGH OR EQUAL	6.4
TZC	TEST ZERO AND COMPLEMENT	14.1
TZE	TEST A ZERO	14.1
XEC	EXECUTE	3.2

GE PAC 4000

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

FORTY FIFTY - II main frame

COMPUTER TYPE: Binary, fixed point

CIRCUITRY: Solid state, silicon semiconductors throughout

ENVIRONMENT: 32 to 131°F; 5 to 95% RH

MEMORY: Temperature-regulated magnetic core
- Capacity: 4096 to 65,536 words
- Cycle Time: 3.2 μs
- Overlap: Above 16 K

BULK MEMORY: Magnetic Drum
- Capacity: 16,386 to 262,144 words
- Access Time: 8.5 ms avg
- Transfer Rate: 61.5 K char/sec

Magnetic Disc
- Capacity: 262 K words/disc, 1 to 16 disc/control
- Access Time: 5 ms/track, Rotational delay 50 ms
- Transfer Rate: 163.8 K char/sec

WORD SIZE: 24-bits plus parity

INSTRUCTION EXECUTION TIMES:

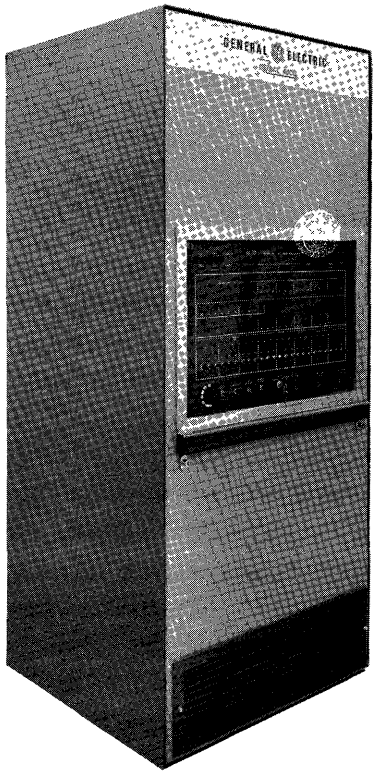
Add	6.4 μs	Floating Point Hdw.	option
Multiply	18.2 μs	I/O Word Rate	313 kc
Divide	29 μs	Levels of Interrupt	to 128
Full Shift	14.1 μs	Lines of Interrupt	to 2000

NUMBER OF INSTRUCTIONS: 113

Words/instr	One
Bit/char. Manipulation	Yes
Repeat Command	Yes
Index Registers	Seven

I/O EQUIPMENT:

Typewriters	10/15 cps
Paper Tape Readers	100/200 cps
Paper Tape Punch	120 cps
Card Readers	30/to/300 cpm
Card Punch	100 cpm
Line Printers	120 col, 300 lpm 12 col, 1200 lpm
Magnetic Tape Transfer Rates	37.5/75/150 ips 7.5 to 120 kc
Operator Consoles	Many standard models available
Digital Clock	Memory clock in hours, minutes, seconds
Display Devices	CRT, trend recorders, annunciators



PROCESS COMMUNICATIONS:

Analog Inputs	8 to 2048 pts/control, 2 & 3 wire, 40 to 200 pts/sec.
Analog Accuracy	.1% of full scale
Analog Range	10 millivolts to 10 volts
Contact Inputs	Groups of 20 at computer execution rates
Pulse Inputs	Any number at computer execution rates
Analog Outputs	to 64 or more of up to 12-bit resolution
Contact Outputs	Groups of 16

Numerous other interface items as required by processes.

2/66 (1M) Litho in USA

GENERAL ELECTRIC

PROCESS COMPUTER SECTION

PHOENIX, ARIZONA

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 30
April 22, 1966
D. E. Lauck, Editor

NEWSLETTER

FREE—TIME SYSTEM CAPABILITIES OVERSTATED BY MAGAZINE

The February 1966 issue of Control Engineering has a mention of our Free-Time System and what it will do. Under the heading of "journalistic license" they stated the Free-Time System "takes care of bulk core allocation of programs and data, and updates stored tables of data."

Presently there is no plan to include updating of tables on bulk memory within the Free-Time System. Data areas of bulk storage must be mapped by system programmers, i.e., data storage and retrieval is the responsibility of the individual system program.

In your discussions with customers, if the subject is brought up, please point out that the Control Engineering writer simply became overzealous in telling his readers about the Free-Time System. He 'wrote in' some functions we didn't claim we would perform within the Free-Time System.

ARE YOU UP TO DATE?

John Singer is now working out of the San Francisco ISD office.

His new mailing address is:

General Electric Co.
235 Montgomery Street
San Francisco, Calif. 94106

Art Cook and John Warren have a new address too:

General Electric Co.
1020 Lakeside Ave.
Cleveland, Ohio 44114

PCBS AD SCHEDULE SUPPORTS CHEMICAL MARKET PUSH

The ad (PCA 069-31) which appears on page 4 of this NEWSLETTER is scheduled as follows:
OIL & GAS JOURNAL -- May 16*
CONTROL ENGINEERING -- March
CHEMICAL ENGINEERING -- April 11
CHEMICAL WEEK -- May 14

The GE/PAC ad on food processing (PCA 069-29) will be seen again in the May issue of FOOD PROCESSING and our textile ad (PCA 069-30) will appear in the May issue of TEXTILE WORLD.

3 PLANS & 33 PRODUCTS ANNOUNCED TO HELP YOU SELL GE/PAC

Three plans are now available to give you the widest possible range of purchase plans for GE/PAC 4000 process computer equipment for your customers...a purchase plan, a five-year lease plan, and a 12-month minimum rental plan on system hardware.

Under the purchase plan, the user is entitled to a credit of seven-and-one-half percent on the list selling price for prompt payment. The seven-and-one-half percent list credit is also extended if your user converts a five-year lease contract or a rental plan to an outright purchase within six months after installation.

The new purchase plans you are offering will enable your customer to optimize his profits most rapidly by use of the purchase plan for outright sale. In those few installations where a lease or rental may be required, a standard G-E Five-Year Lease is preferable over a rental to both your customer and your Company.

New Prices, effective April 25th, will be announced in the Apparatus Handbook (Section 8700) on May 9th. These new prices for the GE/PAC 4000 process computer equipment are less than any previous G-E process computer models, and this equipment now provides 20 to 50 times the performance of the first General Electric process computer, the GE-312.

The new price list was prepared after intensive study of the competitive marketplace, and figures are aimed at eliminating price/performance objections. This means you should expect to use these prices without modification to secure business.

Prices for new additions to the product line will also be published in the Handbook pages. Among the 33 additions are the GE/PAC 4020 central processor, the GE/PAC 4050-II central processor, remote scanners, high-speed scanning equipment and communication data links. The new pricing information will also include separate pricing for supporting services such as programming, systems engineering and maintenance.

The PCBS marketing philosophy is to solicit those process automation computer applications which have sufficient customer savings and benefits to permit recovery of the GE/PAC 4000 system costs in 24 months or less. Marginal systems with debatable customer savings, insufficient hardware, insufficient systems design or software tend to produce unsuccessful installations. As members of "the Company that Cares," we should not in any way encourage a customer to undertake a project which is likely to be unprofitable or unsatisfactory to him.

GENERAL ELECTRIC

GE/PAC 4000 PRIMER

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

TIME CONSIDERATIONS

Time is one of the bases on which computer performance is judged, and for a very good reason. If two computers cost the same amount of money and one can calculate a process line set point in half the time it takes the other, it is obvious the fast computer can do its work at only half the cost. Thus, we are continously striving to make our computers faster and more efficient than those of our competitors.

To give you an idea of the speed of a GE/PAC computer, how long would it take you to multiply 16,777,215 by 12,128,306 using pencil and paper? We didn't actually do the calculations, but a good guesstimate would be 15 minutes. A GE/PAC 4060 or 4020 will do it in 15 microseconds, or 60 million times as fast as the pencil and paper method. A 30-06 rifle with a muzzle velocity of 2900 feet per second will push the bullet just one-half of one inch during that same slice of time, 15 microseconds.

The time intervals we use in the computer business are:

Seconds
Milliseconds -- thousands of a second (ms)
Microseconds -- millionths of a second (μs)
Nanoseconds -- billionths of a second

1 millisecond = 1000 microseconds
1 microsecond = 1000 nanoseconds

READ TIME is the time interval between the instant at which information is called for from storage and the instant at which delivery is completed. For the GE/PAC 4020 this is 1.6 μs.

WRITE TIME is the time interval between the instant at which information is ready for storage and the instant at which storage is completed. For the 4020 this is 1.6 μs.

ACCESS TIME is the read portion of the read/write cycle. For the GE/PAC 4060 it is 640 nanoseconds, two pulses of the 3.125 MC clock.

MEMORY READ/WRITE CYCLE. In reading a word in core memory the information is destroyed in the process. Therefore, it is necessary to restore the information after it has been read. The cycle of reading and restoring is called the MEMORY CYCLE or MEMORY READ/WRITE CYCLE. This is 1.6 μs for the 4020 and 4060.

WORD TIME is the time required to transport one word from one storage device to another and is the same as the MEMORY CYCLE TIME ---- 1.6 μs for 4020 and 4060.

INSTRUCTION TIME is the time required to decipher the instruction and to execute it. The instruction, LDA, means, "Load the contents of a memory location, which we will call Z, into the A register." The contents of Z remain unchanged. In other words, we merely wish to copy the contents of location Z but leave them unchanged, for future use. As we have already mentioned, it is necessary to destroy the contents of a memory location in order to read it. Therefore, the information must be rewritten back into the location after the "read" cycle. Thus, the execution time for the LDA instruction requires one word time for decoding and one word time for the read/write cycle. For the 4060 and 4020 this would be 2 x 1.6 μs or 3.2 μs.

INTERRUPT is a hardware means of interrupting a program while it is being executed. It permits breaking into the normal sequence of a program by a random occurrence or events which are scheduled in relation to time. Non-inhibitable interrupts have high priority over other events. The program has no control over them. A program interrupt acknowledging the event will be made within 1 to 82 μs after the interrupt occurs.
An inhibitable interrupt will be delayed until the program permits it to be serviced. Interrupts are vital to a process computer because they provide the means for it to opperate in real time and respond to events in the outside world as they occur.
After the interrupt has been serviced, the program resumes its operation just as though it had never been interrupted.

CLOCKS. When we think of a clock we usually think of a device which keeps track of the time of day.
The name, clock, has a broader definition in computer terminology. All of the computational processes in the computer respond to timing pulses very much the same way that a column of marching soldiers stays in step by keeping time with the beat of the drum.
The clock in the 4060 computer is a 3.125 megacycle crystal controlled oscillator. The 4020 has a 10 MC oscillator.
All of the logic gating to set up correct current paths through the X, Y, sense, and inhibit wires and actual application of current, is controlled sequentially in an orderly fashion by these pulses. Actually, you can see that the 1.6 μs memory time is quite long --- 1600 nano seconds --- as compared with the 320 ns pulses of the 4060 and the 100 ns pulses of the 4020.
The execution time of any instruction can be calculated in terms of the number of word times and the number of shifts required to accomplish the instruction.
For example, the instruction ABL, which means add or append an item to a list of items residing in memory takes 4 word times and 9 shifts.

	Mem Cy Time	US/WT	US/Shift
4060	1.6	1.6	.320
4050	5.0	5.0	.320

4060: Ex time = 4 x 1.6 + 9 x .32
= 6.4 + 2.88 = 9.3 μs

4050: Ex time = 4 x 5 + 9 x .32
= 20 + 2.99 = 22.9 μs

EDITOR'S NOTE: This article, contributed by Aaron Holland, ISD, Houston, will be continued in a subsequent NEWSLETTER. Also, please note that execution times for the GE/PAC 4050 are for the Mod-I and not the GE/PAC 4050-II (read and write cycle 3.2 us) which was announced in NEWSLETTER 29.

CHECKMATE

the

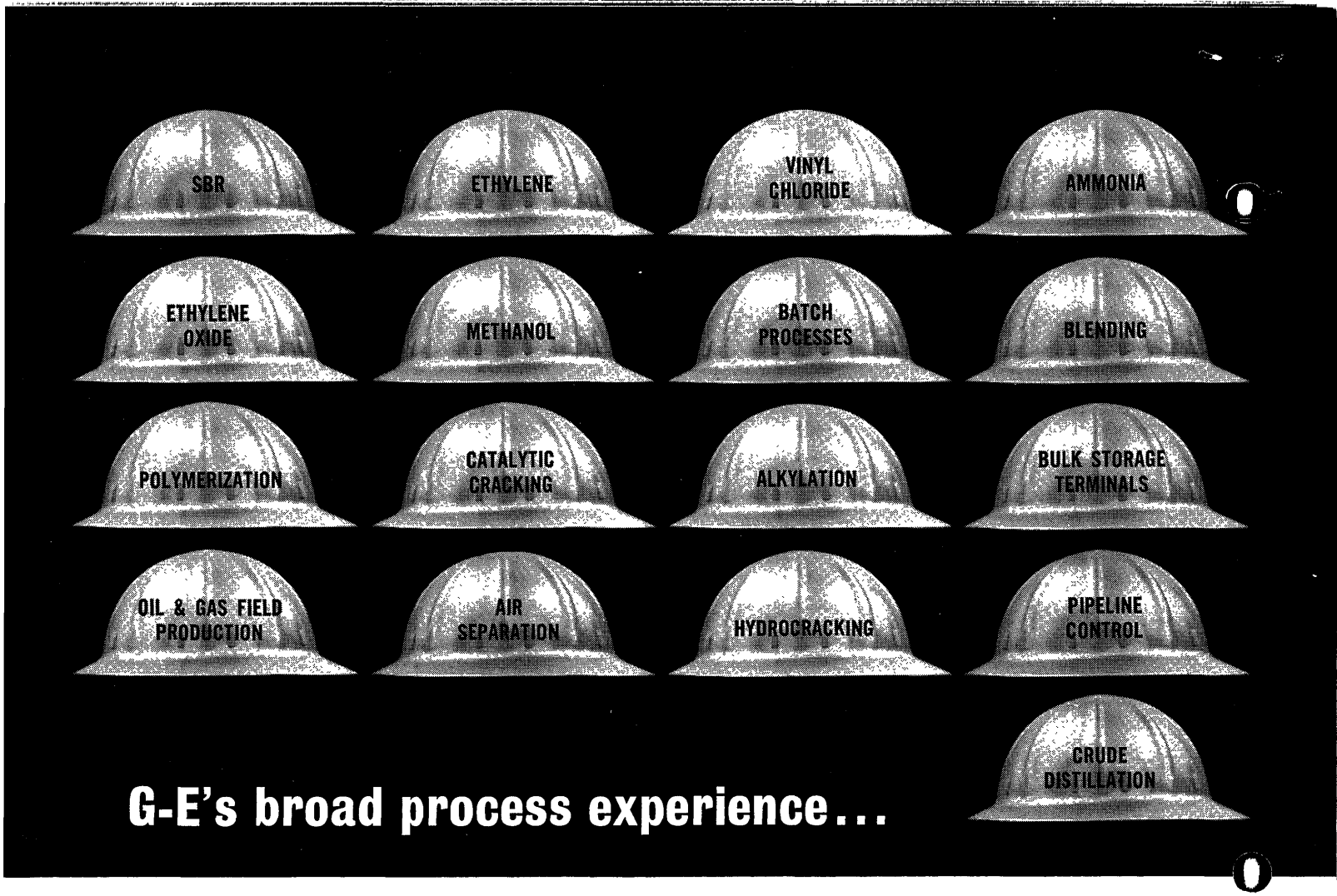
COMPETITION

HOT LINE 8*433 4973

BUSY, BUSY, BUSY ... The Process Computer Marketing "Hot Line" is installed and operating. If you get a busy signal when you dial Marketing people at Process Computer Business Section, call the Marketing Hot Line, 8*433-4973, and ask the secretary to have your call returned by the person you are trying to reach. The only message the secretaries will take on this number is your name and phone number. Elapsed time per call is expected to be 30 seconds or less, so if the number is busy, try it again the next minute.

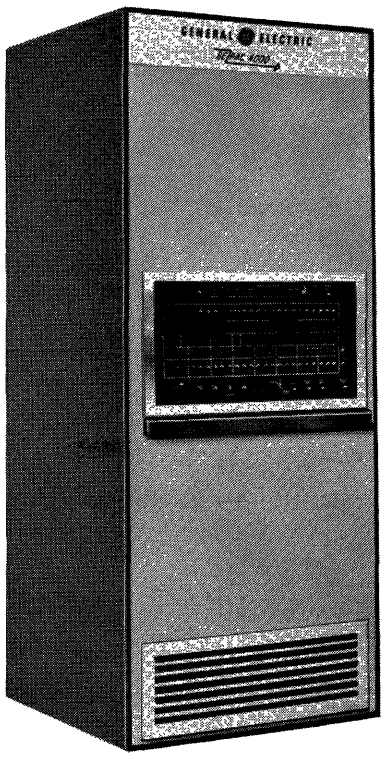
PROCESS COMPUTERS

Phoenix



gives you quicker startup and earlier payout

with GE/PAC*4000



General Electric Process Automation Computer

No other computer manufacturer can offer the years of experience and unique store of application knowledge in chemical and petroleum process control that is available to you from General Electric. G-E systems engineers pioneered computer-controlled catalytic cracking and can now point to more than 50 other applications, from ammonia production to pipeline control. This same engineering talent, coupled with the proved advantages of the GE/PAC 4000 line of process control computers, can identify your process problems faster, give you an earlier *operating* computer installation and yield quicker return on your investment dollar. Any wonder that General Electric is No. 1 in chemical and petroleum process control?

There are G-E sales and application engineers in over 110 offices throughout the nation to serve you. *Contact your nearest General Electric Apparatus Sales Office or the PROCESS COMPUTER BUSINESS SECTION, P. O. Box 2918, Phoenix, Arizona 85002.*

*Trademark General Electric Co.

PCA 069-31

GENERAL ELECTRIC

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 31
May 16, 1966
D. E. Lauck, Editor

NEWSLETTER

FIND A FOUNDRY SELL A GE/PAC 4000

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

by George Barriger
Heavy Industry Sales, PCBS

A recent survey indicates that presently in the United States there are approximately 5000 foundries. Of these, it is estimated that 10% have production capacities and facilities to economically justify a process computer. Functional areas of justification will vary with each foundry. The following areas are most common in the larger foundries and are presently the best prospects for computer control.

Laboratory Spectrometer Output and Charge Calculations.

The computer receives a metallurgical analysis by element from the laboratory spectrograph of the sample taken from the cupola. This sample analysis is instantaneously typed out on the output typewriter in the metallurgical laboratory. Sample analysis data is then compared with desired composition. The computer then types out, in the laboratory and charging area, data on the cupola as charged versus analysis and in real time will solve the charge calculation equations for charging instructions.

Power Demand Limiting.

Various heavy plant power usages are inputted to the computer. The optimum power usages within the framework of the utility contract and production factors will be calculated and typed out and alarmed when power usage approaches a maximum acceptable level.

Mold Quality Control.

This function consists of correlating the time a given mold is on the line to metallurgical acceptance or rejection as determined by lab analysis. The computer receives mold identification data from the pouring station and from the shake out area. This allows the computer to calculate the time the mold is on the line and to correlate this time with the metallurgical analysis for acceptance or rejection. The system will alarm if either metallurgical content or time on the line is out of limits. A log will be produced by the computer for molds poured, shaken out, and accepted or rejected.

Scrap Quality Control and Accounting.

The scrap quality control function consists of manual identification of scrap by quality control inspectors from appropriate locations in the plant. Scrap

(Cont'd on pg. 2)

POW! AN ECONOMICAL FIRST STEP INTO COMPUTER CONTROL

Now you can offer a basic computer-controlled blending function to your customers for $65,000. Applicable to any blending function, wet or dry, the computer system will give your customer a small system which can be expanded to include additional functions when he sees the payback dollars rolling in from the first increases in product uniformity, reduced operating cost and better utilization of raw materials.

Included in this system are a GE/PAC 4040 computer, operator/computer communication, computer system engineering, mathematical analysis, programming, on-site services and training of purchaser's personnel.

The system, when applied to the cement industry, affords more stable kiln control because of more on-target kiln feed mix. The system considers both long-term objectives such as quarry limitations and short-term objectives such as minimizing purchased additives. The customer can use either a laboratory X-ray unit or wet chemical analysis data input via the I/O teletyper as input to the computer. The computer also receives input data from weigh scales. Split-second calculations are made and feeders are automatically adjusted for required blend of materials. This action is repeated at regular intervals to provide a close-tolerance mix which contributes to stable kiln control.

The raw mix blending application described above is only one example of the numerous blending operations in industry today. The blending of any materials controlled by a GE/PAC computer can mean more uniform quality, lower operating costs and better utilization of materials for your customers.

Payback figures for systems of this type and many others can be found in the Process Computer Concepts Course, PCP-55. So whether you are selling to cement mills, electric utilities, steel mills, petro/chemical plants, paper mills or whoever, you should have a copy of the Concepts Course in your desk to provide you with economic justification information to back up your sales story. We'll be happy to send you a copy of the booklet. Just drop us a line .... Advertising & Sales Promotion, Process Computer Business Section, Box 2918, Phoenix, Arizona.

GENERAL ELECTRIC

GE/PAC 4000 PRIMER

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

This installment of the GE/PAC Primer concludes the material submitted by Aaron Holland of Houston. Our next Primer will cover the subjects of punched cards vs. punched paper tape and magnetic drum memory vs. magnetic disc memory.

CLOCK IN MEMORY. We have a powerful instruction that enables us to, among other things, keep track of the time of day. This instruction is called DMT and means, "Decrement Memory and Test". Like the clock on the wall, we rely on the 60 cycle power source for a means of keeping time. Each cycle, we have available a pulse which tells us that a 60th of a second has elapsed since the last pulse. All we have to do is keep track of these pulses and we can build a clock in memory that can keep track of seconds, minutes, hours, days, weeks, months, and even years. It can remember that months have different numbers of days and that leap year comes every four years. Here's how we do it.

First, we designate a word in memory at some symbolic location G as a counter and place the number 59 in it. Using a noninhibitable interrupt which responds to the 60 cycle pulses to activate the DMT instruction, the computer stops whatever it is doing for 4.8 μs and subtracts (1) from location G. This continues until the value in G becomes zero. The next time (1) is subtracted from G, the sign turns negative, causing a flip flop to generate a signal called an ECHO. The echo operates an inhibitable interrupt which does two things. First it adds 59 to G, resetting it to count another second. Second, it activates a clock program which adds (1) second to the counter which keeps track of seconds, minutes, and hours.

The word, "BUFFER", in computerology, means about the same thing that "Buffer Zone" means in describing an area between two countries. A "Buffer" in our language is a place to put something temporarily until you need it. Your secretary might give you a slip of paper with someone's request that you phone him. If you are talking on the phone you lay the slip down and refer to it when you have completed your conversation. This permits you to conduct your business in an orderly fashion without being unnecessarily interrupted.

A buffer is a synchronizing element which matches the high internal central processor speed to the slower electro-mechanical speeds of external devices such as paper tapes, card readers, typewriters, and other peripherals. Buffers permit processing to continue while information is being transferred between external devices and the central processor.

Generally, the buffer is a register. A register is an electronic device in the central processor capable of receiving information, storing it, and transferring it elsewhere as directed.

People think three times as fast as they talk. That's why your mind tends to wander while someone is talking. It makes it hard to concentrate because your mind has nothing to do two-thirds of the time while you are listening. It's like trying to drive a 3000 rpm compressor with a 9000 rpm turbine without a gear. It's a mismatch which violates the laws of mechanics.

THE PERIPHERAL BUFFER enables a fast computer central processor to talk to the outside world through slow electromechanical devices and avoids the problems generated in humans by the mismatch in speed between speech and thought.

A teletyper can operate at about 10 characters per second. Thus the machine takes 100,000 us to receive each instruction and execute it --- a very long time! The computer could spend 100% of its time controlling the typer if it had to wait for it. This is where the Peripheral Buffer comes to the rescue. The instruction, "OUT", means "Output to Device" and causes data from the A register to be transferred to the teletype, typewriter, or other device, via the Peripheral Buffer. It takes 27.2 μs to execute the OUT instruction, and then the central processor goes its merry way, leaving the Peripheral Buffer to finish the job. Ten characters per second times 27.2 μs per instruction amounts to 272 us/second required to drive the typer continuously at full speed. This is only .027% of the computer's total time.

The Peripheral Buffer is capable of controlling up to eight devices simultaneously in an "off line" fashion, thereby freeing the computer. Once the command is received from the computer, the PB is on its own. If some mechanical action, such as the stroke of a typewriter key, is required to complete the command function, the PB completes the necessary action without further program intervention. When the device cycle is completed, the central processor is informed and can then take another 27.2 μs to tell the teletype which key to strike next.

GE/PAC's FOR FOUNDRIES
(continued from pg. 1)

identification and quality will be entered into the computer. A daily report will be generated by the computer which will include part number, casting date, hour, pattern number and cause (defect) area. Weekly and monthly reports will also be generated. The computer system will output on demand the total cumulative status of scrap correlated to the parameters identified in the daily report. With the installation of this function scrap may be correlated to charges, heats, molds, or cores on a real-time basis.

Control of Cupola Operation.

The overall objective of computer control of the cupola furnace is optimum operation. A mathematical model of the cupola is used to determine furnace charge and the required blast characteristics. Day to day variations in production requirements, product specifications, materials costs and other known characteristics will be entered into the computer. The computer will also receive such inputs as stock gas temperature, blast temperature, pressure, humidity, metal temperature and weight directly from on-line instrumentation.

Using the mathematical model the computer will determine the weights of the materials to be charged based upon desired metallurgy, costs of materials and furnace condition to provide the most optimum operation. The mathematical model will also be used to determine the blast rate and blast temperature required.

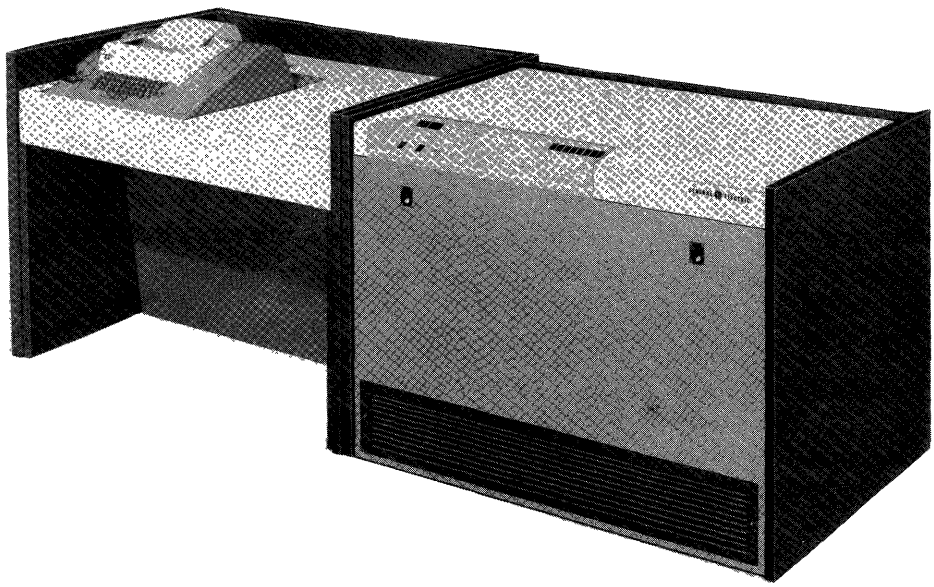
Results of work done by General Electric's own foundry people and Internal Automation Operation will be made available to our customers. This includes regression analysis work as well as work being done in the areas of solidification patterns of castings, casting defects analysis, core moisture and manufacturing scheduling.

We will work with the customer on any reasonable basis, whether it be as an equipment supplier only, or sharing the system responsibility with the customer or accepting turn key responsibility. In addition, our Internal Automation Operation is available at standard fees to do studies for our customers.

GE/PAC 4020

The GE/PAC 4020 photos at left and below illustrate the compactness and configuration versatility of the newest member of the GE/PAC family. The central processor cabinet is only a little larger than a standard desk. The keyboard and paper tape input/output unit may be desk mounted as shown or a free standing unit mounted on its own pedestal. The use of integrated monolithic circuits and high density GEAPS* packaging made the size reduction possible. Magnetic core sizes for the GE/PAC 4020 range from 2000 words to 32,000 words. Core memory cycle time (24-bit word transfer) is 1.6 us.

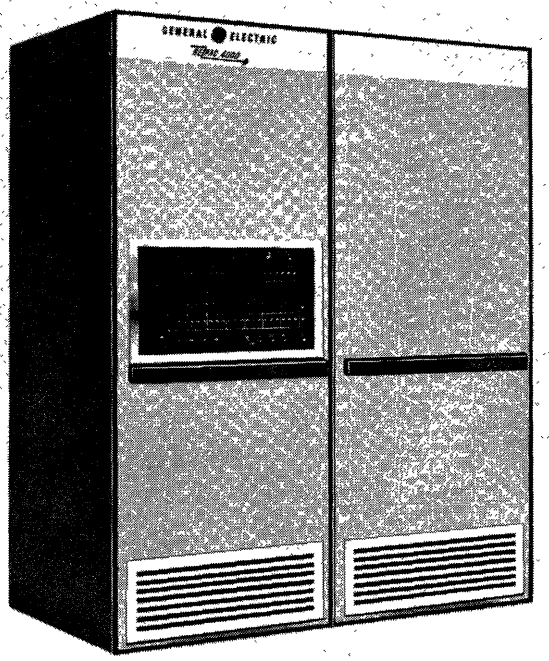
*General Electric Advanced Packaging System



The ad on page four of this NEWSLETTER will appear in the June issue of ELECTRICAL WORLD and the July issue of ENERGY INTERNATIONAL. Watch for it. Use it to help sell GE/PAC.

Nuclear power plants designed for reduced operating costs are designed with GE/PAC® systems

General Electric Process Automation Computers

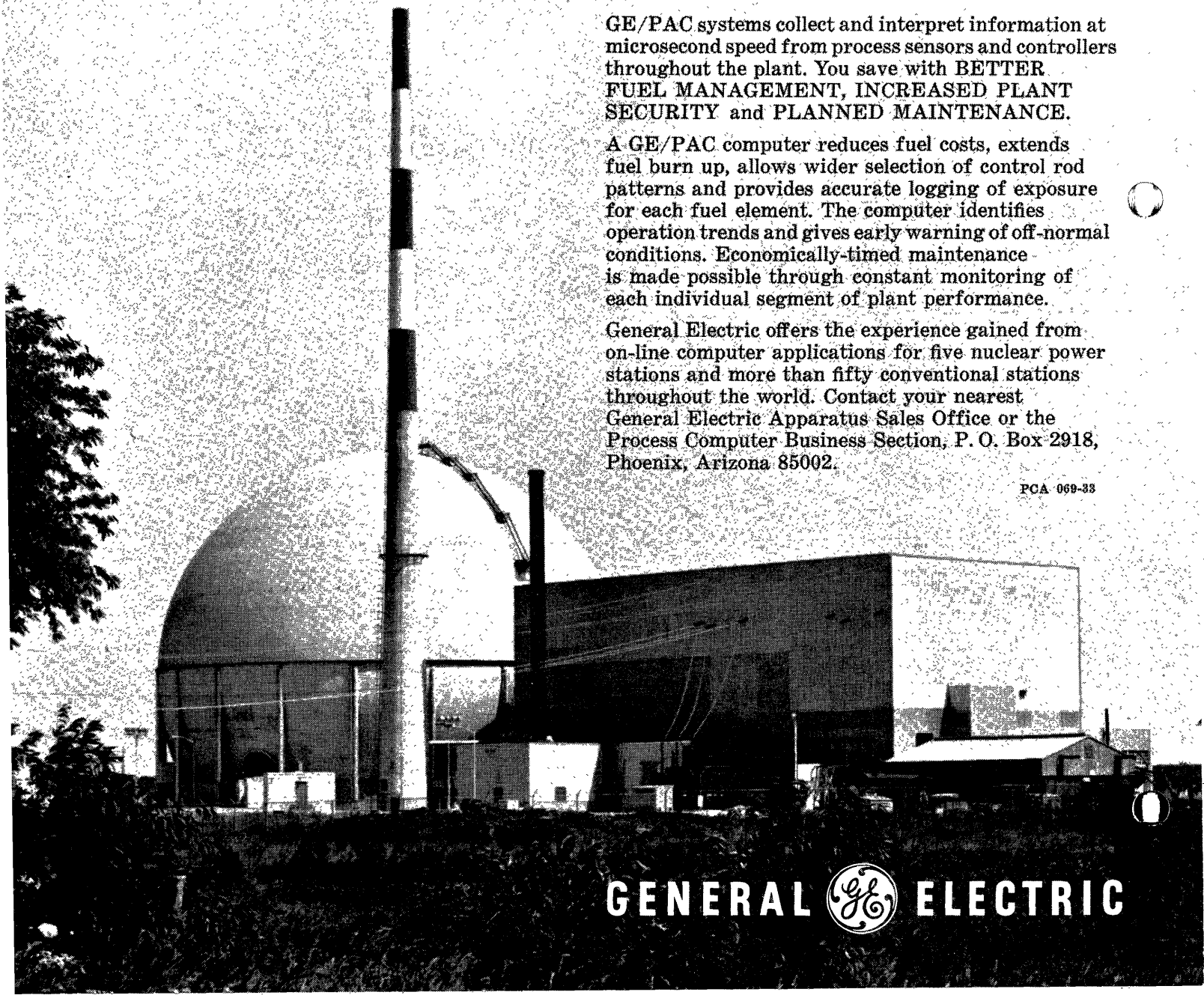


GE/PAC systems collect and interpret information at microsecond speed from process sensors and controllers throughout the plant. You save with BETTER FUEL MANAGEMENT, INCREASED PLANT SECURITY and PLANNED MAINTENANCE.

A GE/PAC computer reduces fuel costs, extends fuel burn up, allows wider selection of control rod patterns and provides accurate logging of exposure for each fuel element. The computer identifies operation trends and gives early warning of off-normal conditions. Economically-timed maintenance is made possible through constant monitoring of each individual segment of plant performance.

General Electric offers the experience gained from on-line computer applications for five nuclear power stations and more than fifty conventional stations throughout the world. Contact your nearest General Electric Apparatus Sales Office or the Process Computer Business Section, P. O. Box 2918, Phoenix, Arizona 85002.

PCA 069-33



GENERAL ELECTRIC

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 34
July 22, 1966
Dale E. Lauck, Editor

NEWSLETTER

CHECKMATE

APPARENT DELAYS IN DELIVERY DATES

Your cooperation is needed in communicating workable delivery promises to customers!

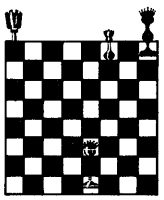
All sales and application engineers and all contracts administrators must, without fail, make clear to customers that the Process Computer Business Section cannot begin work on any offer for a GE/PAC process computer until full information pertaining to the specific order is received in Phoenix. Therefore, no delivery date can be promised until such information has been submitted by the customer and is on hand at PCBS.

Customers must be aware that delivery dates are based on receipt of this vital information, not upon indication of the customer's intent to order.

For example, if the Process Computer Business Section promises a delivery in 14 months, it is likely the customer will regard this as 14 months after his intent is given. Much too often he does not give us the information we require for several additional weeks or months; then we are short-changed by that length of time. This immediately puts PCBS behind schedule. A probable result of this is that delivery according to the customer's assumed plans will be impossible.

Some customer goodwill may be lost unnecessarily.

So impress upon all your customers the need for receipt of complete information before a delivery date can be promised. This may also aid prompt receipt of this material. An unfortunate misunderstanding in promising a time-table for computer installation is not reason for customer dissatisfaction.



RISING COSTS AND OBSOLESCENCE RIPEN FOOD PROCESSING MARKET

Another market is ripe...the food processing industry! Opportunities for selling process control computers are ready for picking in this market now.

Food processing today is accomplished with a high degree of mechanization but little automation. Although most processing plants have been built since World War II, many are now characterized by out-of-date and eccentric local designs. Most food processing machinery is extremely complex, but many of these complexities are operator-designed refinement of questionable value.

Unbounded opportunities for process computer applications are presented by the food processing industry. The market has too long awaited its share of the savings inherent in process computer operations.

The nature of the processes involved, and their similarity to those which are controlled successfully by computers in other industries, indicates the technical feasibility of computer control. Rising labor and materials costs, stiff competition, advancing technology and resultant machinery obsolescence plus the demand for new food products suggest a budding market for process computers.

The points covered here should provide you with approaches to interest food processors in GE/PAC process computers. Once serious prospects are identified, the Process Computer Business Section is ready to work out specific application details for process computer control.

Typically, work forces in food processing plants are composed of large numbers of unskilled workers. A few highly experienced employees supervise blending operations, but there is little sophisticated knowledge of the complex chemical reactions involved.

Raw foodstuffs are blended within fairly wide tolerances to produce a product of fixed specifications. For example, any three of up to seven oils are blended by an empirically determined formula to produce a salad oil base. Type and quantity of raw materials are generally determined on the basis of availability.

(Continued on page 2)

NEW BULLETIN ON FREE-TIME SYSTEM NOW AVAILABLE

A new four-page brochure (GEA-7288) describing the GE/PAC Free-Time System is fresh off the press!

This attractive piece will prove valuable in illustrating to your customers the following advantages they can derive from a GE/PAC Free-Time System.

+ The GE/PAC Free-Time System allows you to realize 100 percent usage of the computer logic and arithmetic capabilities.

+ The GE/PAC Free-Time System provides both off-line and on-line computation within a single computer.

+ The GE/PAC Free-Time System offers a Language Processing and Debugging System, including both FORTRAN and PAL for testing convenience.

+ The GE/PAC Free-Time System features an expandable library of programs.

+ The GE/PAC Free-Time System incorporates process program protection.

+ The GE/PAC Free-Time System provides automatic memory allocation.

This new brochure presents in graphs and diagrams a description of the capabilities and advantages of using a Free-Time System to receive greater usefulness from a GE/PAC process computer and explains how the system is integrated into a full GE/PAC system hardware configuration.

PROCESSING MARKET MATURES

(Continued from page 1)

In some cases a reblend is possible for final achievement of specifications. Computer control offers efficiency benefits by selecting the most economic combination of ingredients.

Frequently, an oven or freezer or both are used in a single food process. The control problem is to maintain the specified temperature over a period of time. Usually this control is by a set of electro-mechanical devices using recording instruments. Computer control of this type of process is commonplace in other industries. Benefits are a better quality product with fewer rejects and more efficient operation.

Process flow can be more precisely controlled if the various machines are tied together by conveying systems and the entire process is placed under computer control. Most food processes are of the batch type, although, there are often phases in the flow which are continuous. This combination presents severe problems when the operation is manually controlled.

Inventory levels of raw materials, packaging materials, in-process stocks, and finished product are typically controlled by visual check. A more precise knowledge of these inventories and the duration of the production cycle will often allow a significant reduction in these levels. Frequently the reduced cost of the warehouse space alone can justify a process computer.

A computer would also reduce labor costs, improve operation and provide better in-process inventory control.

Most food processors have at least a small research staff. The main concern of these departments has been the study of food technology to control bacteria and other contaminants. However, these staffs are becoming increasingly involved in developing new blend formulas, researching new products and studying food economics. Few of these staffs are large enough to operate a computer on a full-time basis, but, a Free-Time System built into a process computer would easily satisfy their research requirements.

An apprenticeship system, designed to produce skilled blenders, is deteriorating because an insufficient number of young men are entering the trade. Food processors are gradually losing the handed-down knowledge and skill of the industry. Scientific studies of food processes, required for process computer automation, would capture this knowledge.

Basic instrumentation and related control procedures in the food industry are generally so imprecise that the capital investment required for process computer installation would be high because of the necessity for intense study of the food processes. It is this difficulty, compared to the relatively direct application of computers in the more established markets, which has inhibited penetration of the food processing market.

The pressures of rising labor and material costs are reducing the thin profit margin to the point where the food processing market is ripe. Competition will not let this market spoil, so we must hasten to harvest our share. Would you believe 100%?

SEE FOLLOWING PAGES FOR GE/PAC 4020 DATA

Pages 3 and 4 of this NEWSLETTER contain a two-page compilation of technical data describing the new GE/PAC 4020 process computer. This data sheet should provide fast and convenient reference for comparing the 4020's capabilities with competitor's models. File for your future reference.

THE GE/PAC 4020: A DESIGN FOR CAPABILITY

General

The 4020 Central Processor Unit is a high-speed, parallel, stored program, digital computer, primarily constructed of integrated circuits and using a ferrite core memory. Most internal operations are parallel, using a 24-bit word. Different type I/O channels provide transfer rates up to 625,000 words per second. The 4020 is effectively a parallel version of a GE/PAC 4040 with some extended capabilities.

The 4020 is only small in physical size. Performance-wise, it may be classified as a medium-size computer. The standard enclosure for the GE/PAC 4020 will be the desk-style cabinet. The upright cabinet is available as an option only.

Memory

The 4020 uses a ferrite core memory expandable from 4,096 24-bit words to 32,768 24-bit words. All instruction and data movement are done in a parallel mode. The memory cycle time is 1.6 usec. Memory cycle includes both the read and write phase. Three memory channels are available to provide direct memory communications at rates up to 625K words/second. Parity is generated and checked on each word.

Index Registers

Like all GE/PAC computers, seven core locations are reserved for index registers. Indexing requires one additional memory cycle time of 1.6 usec. Instructions are provided to increment, load, store, test, etc.

Arithmetic

The 4020 uses a parallel full adder, 24 bits in length, with simultaneous (look-ahead) carry propagation between each four bits. All parallel arithmetic operations are accomplished within the parallel adder. In addition to its arithmetic functions, the adder serves as a hub for most parallel transfers between registers. The adder is also used to perform the logical functions of "OR," "AND," and exclusive OR.

Instruction Repertory

The 4020 instruction repertory includes all of the 4040 instructions plus hardware multiply/divide, load/store Q-register, high-speed GEN II, GEN III, and the TIM/TOM function. The Q-register is location 10_8.

Memory Addressing

There are four methods of addressing core memory: directly, indexed, relative, and indexed relative. Up to 16K words are directly addressable, and any location may be addressed by index address modification. Relative addressing allows the addressing of any cell ±8K from the address of the instruction being executed. Although indexing requires one additional memory cycle, relative addressing requires no additional time.

Automatic Priority Interrupt

The 4020 system API is expandable from 8 to 128 interrupts. This API uses a parallel method of scanning where all interrupts are interrogated simultaneously. Maximum response time to a 128-interrupt module is less than .5 usec.

An optional interrupt mask register is available. This controls up to 16 interrupts, individually, or up to four interrupts may be controlled by each mask bit for a total of 64 masked interrupts.

Memory Protect

The advanced memory protect scheme allows the core memory to be subdivided and protected in blocks of 64 words. This new memory protect approach will define 64 word blocks as:

1. Part of a running program (undebugged program goes here).
2. A Read only data area.
3. A Read or write data area.
4. Inaccessible to the running program (debugged program goes here).

Its purpose is: (This also assumes API watchdog.)

1. To expedite program debugging of both on-line and off-line programs.
2. To confine a running program to its own specified program and data areas.
3. To prevent specified program and data areas from being modified by a running program.
4. To prevent a running program from fetching data from specified program and data area.
5. To prevent a running program from inhibiting interrupt (IAI) for any period of more than 16 milliseconds.
6. To prevent a running program from indefinitely locking out all program interrupts.
7. To prevent specified running programs from issuing I/O instructions.
8. To "interrupt" a running program whenever it attempts to violate any protect constraint; to cause entry to an executive program.

THE GE/PAC 4020: A DESIGN FOR CAPABILITY --

YOUR GE/PAC 4020 DATA SHEET

Input/Output

The 4020 Central Processor Unit may perform I/O operations at basically four levels of performance. These include:

1. Normal GEN II operation.
2. High-speed GEN II operation.
3. TIM/TOM operations (high- and low-speed).
4. Direct memory communications.

The normal GEN II instructions use the A-register and require 26.5 usec. to execute. The high-speed GEN II operates the same but is executed in 8.5 usec. ($K_3 = 7$). The TIM/TOM function bypasses the A-register (leaving it undisturbed) and requires either 12.7 usec. ($K_3 = 7$) or 30.7 usec. to execute. Direct memory communications (via the memory channels) require one memory cycle (1.6 usec.) per word, once initiated. The above execution times are our current closest estimates.

TIM/TOM

The optional, Table Input to Memory (TIM) and Table Output from Memory (TOM), feature adds considerably to the I/O capabilities of the 4020. TIM/TOM are not instructions but are functions which allow the inputting and outputting of data without disturbing the accumulator.

The TIM/TOM function operates in conjunction with interrupts as follows:

1. A TIM or TOM control word is stored into an interrupt response location. This control word contains a starting core address, word count, and packing bits (number of characters/word).
2. A GEN II instruction initiates an I/O device such as a paper tape reader.
3. An interrupt occurs informing the computer that data is available on input or the device is available on output.
4. The TIM or TOM control word is brought from the interrupt response location and examined. The address portion of the TIM/TOM control word tells where the data word is located.
5. The data word is brought from core. If inputting, the incoming character is stored into the least significant bits of the data word and the data word is permuted to agree with the number of characters per word specified (6, 8, or 12 places), in preparation for the next character.
6. The updated data word is stored back into the data table and, if required, the TIM/TOM control word is updated (address plus 1 and word count minus 1) and returned to its interrupt response address.
7. Outputting is the same except the character is taken from the data word and sent to the I/O device.
8. The next interrupt will cause the same action unless N field of the TIM/TOM control word equals all ones which will generate an echo interrupt to inform the program that the end of record has been reached.

GENERAL CHARACTERISTICS	GE/PAC 4020	IBM 1800-2
MEMORY		
Type	Core	Core
Capacity	4K - 32K	4K - 32K
Cycle Time	1.6 usec.	2 usec.
Mode	Parallel	Parallel
Checking	Parity	Parity
WORD STRUCTURE		
Length	25 bits	18 bits
Format	24 data, 1 parity	16 data, 1 parity, 1 MP
Representation	Binary (Octal)	Binary (Hexadecimal)
ARITHMETIC		
Type	Parallel	Parallel
Accumulators	One	One
D.P. Hardware	No	Yes
M/D Hardware	Yes	Yes
F.P. Hardware	No	No
Add Time	3.2 usec.	4.5-6.5 Avg
Multiply Time	8.9 to 12.1 usec.	14 to 17 Average
Divide Time	13.7 usec.	42 to 44 Average
Full Shift	4.8 usec.	5.25 usec.
Product Size	48 bits	32 bits
Quotient Size	24 bits	16 bits
INDEXING		
Number	7	3
Time Required	1.6 usec.	.25 usec.
Increment	Yes	Yes
Decrement	Yes	Yes
Test	Yes	Yes
PROGRAMMING		
No. of Instructions	25 Basic	26 Basic
Words/Instruction	One	One or Two
Addresses/Instruction	One	One
Bits in Address	14	8 or 16
Compare	No	Yes
Quasi	Yes	No
Indirect Addressing	No	Yes
Relative Addressing	Yes	No
Levels of Interrupts	To 16	24
Memory Protect	Yes	Yes

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 36
September 15, 1966
Dale E. Lauck, Editor

NEWSLETTER

COMPUTER CONTROL TO HIGHLIGHT G—E EXHIBIT AT STEEL SHOW

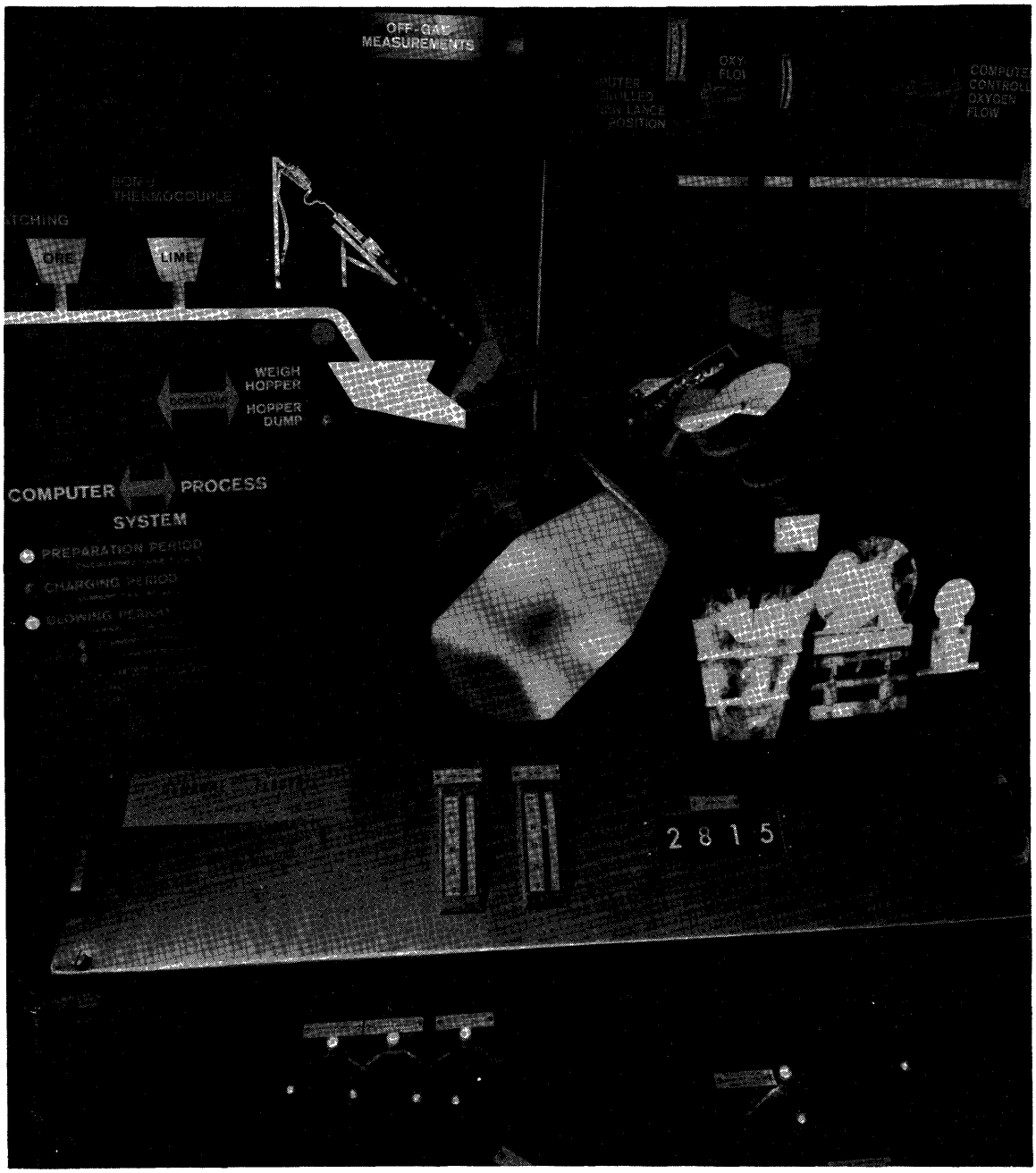


Photo above shows a portion of the General Electric operating display which will be featured at the Steel Show in Cleveland, September 26-29. The animated display, complete with sound effects and blinking push buttons (console in foreground), is expected to be a highlight of the entire 1966 Show. Story on page 2.

GENERAL ELECTRIC

STEEL SHOW EXHIBIT TO FEATURE PROCESS COMPUTER

Final testing and debugging of the GE/PAC* process computer-operated basic oxygen furnace (BOF) steel-making display for the 1966 Association of Iron and Steel Engineers is now being performed at PCBS in Phoenix.

The mock-up and computer system will dramatize computer operation of the steel-making process with the use of animated components and flashing lights to inform spectators of each stage of the process and how the computer controls the entire process sequence while automatically adjusting for different specifications for each batch.

The steel-making display is only half of the show exhibits sponsored by PCBS. There also will be an integrated backwall display portraying the steel producing functions which can be accomplished when GE/PAC computers are used in conjunction with Industry Control Department equipment such as Directo-Matic* II control.

Both displays are designed to make the name GE/PAC a familiar one in the minds of your customers.

The BOF steel-making display demonstrates to prospective customers not only General Electric process knowhow, but also the General Electric approach to the dynamic control of the process by use of a charge calculation and GE mathematical model of the process.

The display consists of a large backwall exhibit and two operator consoles with the GE/PAC computer. The consoles will be used to both operate the BOF and be an aid in visualizing the control operation. After one batch has been produced, an input-output typer types out information relating to that batch. Customers will be able to take the typeout with them after observing operation of the display.

Included in the display are GE/PAC, GE/MAC*, Directo-Matic and JET-BOP* (Lamp Department), equipment systems, as well as more conventional drive and power distribution systems by General Electric. This emphasizes the capability of General Electric to provide complete computer and electrical systems.

*Trademark of General Electric Company

ADS ARE YOUR ADVANCE MAN

To help you sell GE/PAC process control computers, the following advertising space has been purchased for the months of September and October:

	SEPTEMBER	OCTOBER
AUTOMATION		(Parts)
CHEMICAL ENGINEERING	(Process Experience)	
CONTROL ENGINEERING	(Why compromise?)	
ELECTRICAL WORLD		3rd(Nuclear)
FOOD ENGINEERING		(Profits)
OIL AND GAS JOURNAL		24th(Process Experience)
POWER		(Why compromise?)
TEXTILE WORLD		(Functions)

*Registered Trade Mark of General Electric Company

GE/PAC*4000 PRIMER

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

Continued from last issue

Many computers exist that can run programs written originally for other, usually slower, computers, but most of them accomplish it by software simulator or translator programs and in some cases, special-purpose equipment. When both methods are combined, the result is called an emulator. Neither simulation nor emulation allows the faster machine to run at full speed or maximum efficiency.

An example of a subsystem is the analog input scanner. It selects, amplifies and converts to digital form one of the electric analog input signals connected to it. Like most subsystems, this one contains an electronic controller, which takes care of the problems of communicating with the central processor and of actually operating the scanner. The central processor sends one 24-bit control word to a register in the controller. The word tells the controller which point to work on and which of six possible amplifier gains to use.
The controller then carries out this operation and when finished, signals the computer by means of an automatic priority interrupt, more properly termed an automatic program interrupt and in both cases abbreviated by API. This gadgetry causes the computer to put aside what it is doing long enough to accept the digitized value from the scanner and give the scanner another control word. The registers in the controller that hold the control word and the digitized value are examples of buffers. A buffer is a register used to allow two parts of a computer system which operate at materially different speeds, to communicate efficiently, i.e., preventing either from having to wait or suspend operations while the other works. Buffer is also occasionally used in the radio sense to mean an isolating or power amplifier. Another example of a buffer is the seven-bit register used to hold the binary code for a character to be typed while the typewriter types it, very slowly in comparison with the speed with which the computer can load or transfer the code into the buffer.

Other subsystems include the digital input scanner (or selector, or loosely, controller), which reads in groups of 20 bits, each bit coming in as a binary one if the corresponding contact is closed or as a zero if open. Digital means pertaining to digits or numbers and is used by way of contrast with analog, which means pertaining to a continuously variable physical phenomenon. An analog-to-digital converter (or ADC or A/D) converts the former to the latter. A digital signal may represent a decimal quantity (the common number system, based on ten), but if it does, it must either take ten bits, one for each possible value of the decimal digit, or four bits, such as an 8-4-2-1 or other code, or else consist of ten bits or four bits transmitted time-serially over a single line. Another major subsystem is the multiple output distributor (or loosely, controller). This subsystem takes a control word from the central processor and activates various types and arrangements of relays to cause analog or digital outputs, used for control or display purposes. The drum or disc memories are subsystems also and have controllers, buffers, etc.

Peripherals or peripheral devices are devices located around the physical periphery of the central processor. Typewriters (typers), card readers, line printers and paper tape punches are several examples of peripherals.

SE/ER SYSTEM STEPS UP STEAM PLANT PERFORMANCE

Digital computer application in steam power plants is relatively new in terms of years of use, but the evolution of equipment and functional programs plainly show the great strides made by this relatively new means of power plant monitor and operator assistance. The General Electric Company has played a leading role during this period of growth and expanding applications. The experience gained is reflected in the General Electric Steam Electric Evaluating and Recording (SE/ER) System. The programs and hardware features that have been proved by on-line operation and operator acceptance are included to furnish a proved operating system. Programs used are the same as those now operating on many existing systems. The hardware supplied retains that part of the old which has proved its worth but in addition uses the best of the newest and latest design.

The SE/ER System provides economy and assured on-time availability by using developed programs and existing hardware to implement its functions. This economy and availability is not possible using special hardware and programs and makes it possible to furnish the SE/ER System at minimum cost. It is recognized that all boiler-turbine generators cannot use the same programs. However, changes of data provided to the developed programs can make them adaptable to most applications.

The SE/ER System provides a powerful scan, log, alarm and performance calculation digital computer system. It is not limited to the initial definition but as knowledge and acceptance grow, so can the system expand.

The SE/ER System instantly warns the operator when an alarm condition exists within the plant by providing continuous high-speed 40 points-per-second scanning of plant variables. The alarm condition is immediately given to the operator when it is detected using high priority alarm program, not stored to allow a separate alarm program to read the stored data and output the alarm. Only meaningful information is given to the operator by using the Contact Cutout Feature which prevents the scanning of plant equipment not in service. All alarms are recorded to provide an alarm history of the plant operation.

It provides hourly and daily logs of plant variables and calculations. In addition a record of plant variables before and after a plant trip or major equipment failure is provided using the Historical Review Log Program.

The SE/ER System will maintain a complete record of the day-to-day operations of the plant. All alarms that occur, equipment out of service, trends of variables under conditions of load change, etc., are made available for review using the Digital Trend Function of the Special Logs, Analog Trend Recorders and the Alarm Message Output Programs.

The SE/ER System is designed for typical single-unit steam power plant application containing those programs and hardware features most requested by the utility user.

It will increase your sales and help make your budget because:

1. The function/price ratio is completely competitive.
2. It contains what the customer wants and has asked for in over forty GE power plant applications.
3. It answers the customers' questions by giving detailed program description.
4. It provides a powerful expandable digital computer, not a stripped data logger.

The system can be easily expanded as follows:

1. Analog inputs can be added to a maximum of 600 using prices per Apparatus Handbook, Section 8702, page 15 for input switching and conditioning.
2. Digital inputs can be added to a maximum of 216 using prices per Apparatus Handbook, Section 8702, page 16 for signal conditioning and termination.

THE 1800 REVISITED

by Bill Stanger
Contributing Editor

Across the board, the GE/PAC 4020 offers more performance than the IBM 1800. This series of articles will develop that point in each major area of importance--system concept, real-time software, FORTRAN, central processor, process subsystems and peripherals. This article covers the first two areas.

Not surprisingly, in view of its history and area of major strength, IBM approaches the design of any computer from a data processing viewpoint: to run a program, one must first load the entire program into core, then load the data, run the program, and finally dump it and its results out again before starting the next program. This "batch processing" philosophy dates back to the days of tabulating equipment, but is still in use on the 1800 as well as the System 360. On the 1800 this philosophy takes the form of providing enough core for a rudimentary monitor, for all fast-cycling programs, and for an occasional "core load" of information from the disc. When programs from the disc need to be run, they are transferred in by large "core loads", executed, then transferred back to disc, doubling the workload on what is already a system bottleneck.

This approach has several other major disadvantages:

1. It requires a lot of core memory. IBM initially quoted 8K for the 1800's, then 16K and most recently, 32K. A 16K 1800 may or may not provide adequate performance in a given process situation; if it does not, the customer must spend at least another $1000 per month for the next available core size, 32K.

2. System response to changing process demands is slow and inflexible.

3. The load factor on the various parts of the overall system is poor.

To make a rough estimate of how much core an 1800 might require, consider a typical GE/PAC system having 4-6K of core and 10-12K of drum for fast-access MONITOR functions and temporary storage. For comparable performance using a disc, half or more of this material should be in core all the time, making the total GE/PAC core requirement 9-12K. Assuming that the 1800 will require 1/3-1/2 more words than the GE/PAC, it will need at least 12-16K for this purpose alone. And there is still no working area for functional programs, which probably need 4-8K more for a total of 16-24K!

The 1800's "real-time" software has the comparatively easy job of deciding which core load to run next and whether that core load should consist of

(Cont'd pg. 4)

Recognition Accorded PCBS Advertising

When a readership survey indicated that a Process Computer ad scored "best read" in the equipment category of CHEMICAL WEEK's May 14 issue, PCBS was honored with a special plaque. Bud Hogate (center), PCBS Advertising & Sales Promotion, accepts the award from R. L. Yocom, CW Western District sales manager, as P. F. McPherson, CW advertising sales manager, looks on.

The award-winning ad emphasizes how customers benefit from General Electric's experience on such processes as SBR, ethylene, vinyl chloride, ammonia, ethylene oxide, methanol, batch processes, blending, polymerization, catalytic cracking, alkylation, bulk storage terminals, oil & gas field production, air separation, hydrocracking, pipeline control and crude distillation.

In addition to future planned insertions (see schedule on page 2), the ad has also been seen in CHEMICAL ENGINEERING, OIL AND GAS JOURNAL, WALL STREET JOURNAL, CONTROL ENGINEERING, and FORTUNE's special "500" issue.

IBM 1800 (Cont'd from pg. 3)

process-related programs or off-line functions. The 1800's monitor, most recently renamed "Nonprocess Monitor", and the so-called "Time-sharing Executive" or "TSX" make these decisions. Specifically, the programs in a given core load must decide that the process can do without the services of the computer for a period long enough to do a significant amount of off-line work. The period will probably have to be at least a substantial fraction of a minute to be useful.

By contrast a GE/PAC with the advantages of a drum and our far more powerful and sophisticated MONITOR provides much faster and more flexible responses to process requirements and will utilize the various items of system equipment much more fully. The GE/PAC system philosophy is to have MONITOR decide on a second-by-second basis what combination of programs to have in core, on the basis of inherent program priority, time and events. The GE/PAC features of dynamic relocatability and fast-access program storage on drum are both needed to allow this flexibility and to make most efficient use of core.

Another advantage of the GE/PAC philosophy is a much better load factor on all subsystems and peripherals, since the input, computing and output requirements of the larger number of active programs will tend to average out. A better load factor means more work done per dollar and per unit of time.

Finally, GE/PAC programs and software are written to require only a minimum amount of "save status" information to be transferred back to bulk memory, effectively doubling the usefulness of this channel as compared with the IBM approach.

In summary, the 1800's use of disc bulk memory and batch-processing software concepts seriously handicaps its performance in performing efficiently as a real-time process control computer.

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 37
October 20, 1966
Randall H. Larson, Editor

NEWSLETTER

REGIONAL OFFICES PROVIDE STAND-BY ASSISTANCE

The PCBS Regional Projects Offices, primarily designed to perform an engineering rather than a selling function, are nevertheless available for sales assistance when sales engineers are stalled by applications problems.

While only 10 percent of the Projects office's time is normally occupied with selling support activities, an important part of their services is standby engineering aid. This function comes to the rescue of sales forces when highly technical engineering problems arise in tailoring a GE/PAC process computer system to a specific customer's needs.

Normally, however, the regional offices play a silent though essential role in process computer sales. Routine utilization of the regional office is made after the sale of a GE/PAC process computer system.

It is the job of the regional office to step in and make a complete definition of what has been sold and what the new system will entail from the engineering and programming standpoints. Then, Projects engineers provide a functional description of what the system must do. These two steps make up the first phase of the regional office's participation in the sale of a GE/PAC process computer system.

Now PCBS in Phoenix takes over. Until recently, the entire programming operation has been handled at the regional offices. However, with the appointment of William G. Beyer as head of Projects, part of the programming work operation has been transferred to Phoenix, where it can be more closely coordinated with hardware production.

Upon delivery, the role of the regional office resumes. The second phase consists of a last hardware and program check on site and a thorough system demonstration as the system is turned over to the customer.

As the work load on Projects regional offices is increasing with the rising number of GE/PAC computer systems sold, a new office, to serve the eastern region, will open early next year.

With a total of five outlying engineering offices, the Projects staff will be even better equipped to serve you when unique engineering problems arise.

KEEP ABREAST OF GE/PAC WITH LATEST GEA AND HANDBOOK SHEETS

New printed matter has been "pressed" into service to serve you in selling GE/PAC process control systems. Number one on the list is a new GEA-8464, which describes the GE/PAC 4000 production management computer system.

This four-page brochure printed in two colors presents in text and illustration the advantages of the GE/PAC production management system for discrete item manufacturing.

Besides facilitating production itself, such a system provides better shop management, better maintenance scheduling, and expansion capability for additional monitoring. The system can be linked to a previously installed business computer in two ways, by punched tape or an optional communications link.

Another selling point is that the system is backed by General Electric experience in design and manufacture.

Also newly available are Handbook sheets 8702 page 1 and 8730 page 1. The first specifies PCBS policies in regard to customer prints and instruction books furnished with GE/PAC orders and prices for extra quantities. The second describes GE/PAC software.

Copies of these pages have been distributed to Apparatus Handbook lists.

WHEN TIME IS MONEY IT PAYS TO KNOW WHERE TO GET WHAT PUBLICATION

In order to speed receipt of your requests for PCBS process computer literature, the following explanation of the PCBS publication numbering system is included in this NEWSLETTER.

All publications with the designation letters "GE" or "IPC" can be ordered from the Advertising and Sales Promotion Distribution Center in Schenectady.

Publications covering business computers such as The Compatibles 400 and 600, the GE 200 series, and the GE 115 are prefixed "CPB" and should be ordered directly from the General Electric Information Systems Marketing Operation, Publications Distribution (Bell Road), P. O. Box 270, Phoenix, Arizona 85003.

For publications bearing a "PCP" number, write directly to Advertising and Sales Promotion, Process Computer Business Section, P. O. Box 2918, Phoenix, Arizona 85002.

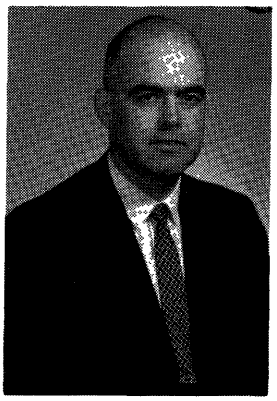
GENERAL ELECTRIC

NEW NAMES, POSITION MARK GROWING PCBS ORGANIZATION

CARL F. RAINE

Three important personnel changes are now in effect at PCBS. Announcement of the changes was made at the 1966 Iron and Steel Show in Cleveland (September 26-29) by R. C. Berendsen, PCBS manager.

C. F. Raine has been named new marketing manager of PCBS.



Raine brings to his new G-E assignment a broad background in process computer marketing and engineering. He graduated from Tufts University in 1954 with a BSEE degree (cum laude) and later continued graduate studies at Arizona State University, Tempe.

In 1956 he joined General Electric Company's Marketing Training Program and performed assignments in Pittsfield, Mass.; Tyler, Texas; Schenectady, N. Y.; and Evendale, Ohio. In 1957 he joined G-E's Computer Department in Phoenix, starting as a product planner, working out the details of the early General Electric process computer product line. Later, he moved to senior sales engineer to help develop the market for GE process computers in the petroleum refinery and chemical industries.

In 1961 Raine joined the UNIVAC Div., Sperry Rand Corp., St. Paul, Minn., as program manager for several computer systems and moved up to director of product planning, responsible for formulation of new product plans and marketing for all commercial products.

He returned to General Electric Company's Information Processing Division's Planning Operation staff in Charlottesville, Va., in 1964 as manager of advanced product development. In that capacity, he was responsible for coordination and long-range direction of product plans and research and development projects for all information processing products of the division, especially the coordination of the division's domestic and foreign interests.

After graduating from Tufts, he served two years in the U. S. Navy and currently holds a commission in the USN Reserve Civil Engineering Corps. He is a member of the Tau Beta Pi, engineering scholastic honorary society; Instrument Society of America, and Delta Tau Delta social fraternity.

WILLIAM G. BEYER

William G. Beyer has been appointed to the newly established position of projects manager of PCBS.

Prior to his new assignment, Beyer had been a project manager for special systems at PCBS since 1961. From 1952 until 1961, he was a project engineer for Leeds and Northrup Co., Philadelphia. In that capacity, Beyer was closely associated with the design and development of instrumentation and control systems, and development of data processing for industrial controls.

A native of Philadelphia, and a graduate of St. Thomas More High School, Beyer received a BSEE in 1956 and a MSEE in 1961 from Drexel Institute and joined General Electric shortly thereafter. He ranked first in his undergraduate engineering class, received the G. W. Childs Scholarship, and was elected to Alpha Sigma Lambda honorary fraternity.

The new function is responsible for the administration of all requisition engineering, requisition programming, and regional engineering and programming activities.

Beyer is a member of IEEE, Instrument Society of America, and the Franklin Institute.

RICHARD A. JIMMO

Richard A. (Dick) Jimmo, has been appointed manager of manufacturing at PCBS.

A native of Colchester, Vt., he is a graduate of the University of Vermont with a Bachelor of Science degree in mechanical engineering.

Jimmo came to General Electric in 1951 on the company's test program, on which he performed assignments in Burlington, Vt., and in Syracuse and Schenectady. He later was accepted on the Schenectady Factory Works Training Program, where he worked in Manufacturing Engineering and Quality Control.

In 1957 Jimmo was transferred to the Outdoor Lighting Department in Hendersonville, North Carolina. There he held such positions as manager of quality control, programming manager and superintendent of shop operations.

Before coming to PCBS, Jimmo was manager of the Switchgear plant at Burlington, Iowa.

'COMPETITIVE EDGE' FOCUSES IN ON GE/PAC AT WORK

RELEASE DATE SET

FOR LATE 1966

R. F. Hogate, head of Advertising and Sales Promotion at PCBS, has been working on location for two weeks with camera crews filming "The Competitive Edge," a 20-minute 16 mm sound and color film, promoting GE/PAC plant automation to meet the increasingly acute competition in today's business world.

The film is designed as an attention getter and interest builder for higher management circles.

GE/PAC system installations to be shown in the film include a steel plant in Portsmouth, Ohio; a large railroad classification yard in East St. Louis, Ill.; a paper mill in Cedar Springs, Ga.; an oil refinery in Deer Park, Tex.; power plants in St. Petersburg, Florida and Dallas, Tex. Locations in California will also be included.

Release date for the PCBS film is set for late 1966.

NEW BROCHURE COMING TO DESCRIBE SE/ER SYSTEM

The General Electric Steam Evaluating and Recording (SE/ER) System, described in Newsletter No. 36, will soon be treated in a separate brochure (GEA-8465).

The SE/ER System provides economy and assured on-line availability in GE/PAC power plant applications. It incorporates a powerful scan, log, alarm and performance calculation digital computer system without special hardware or software.

The sales brochure will be six pages, printed in two colors.

LOG SHEET DATA VITAL PART OF GE/PAC ORDER

Specifications for a GE/PAC process computer system are not complete until log format information has been received by PCBS. In the past, deadline problems have arisen when customers and sales people have believed specifications to be complete without log form information being included in the order.

The Process Computer Business Section is under contract to supply a year's supply of log sheets with every GE/PAC order. It is vitally important that this information be correct and submitted on time! Each utility computer system uses a customized log sheet. It is necessary to design each one indivdually and produce each one by hand. Proper time limits must therefore be observed.

The information must be forwarded to requisition engineering through the project engineer on the particular requisition. Here the job requirements are reviewed and turned over to the drafting department to make up a large set of drawings suitable for publication. This work takes approximately two weeks.

If the drawings must be sent to the customer for approval, there is a delay of about four weeks. After the drawings are returned, corrections may be necessary. Next, the drawings are entered into the PCBS drawing system and sent to a vendor for log format proofs. This takes three weeks.

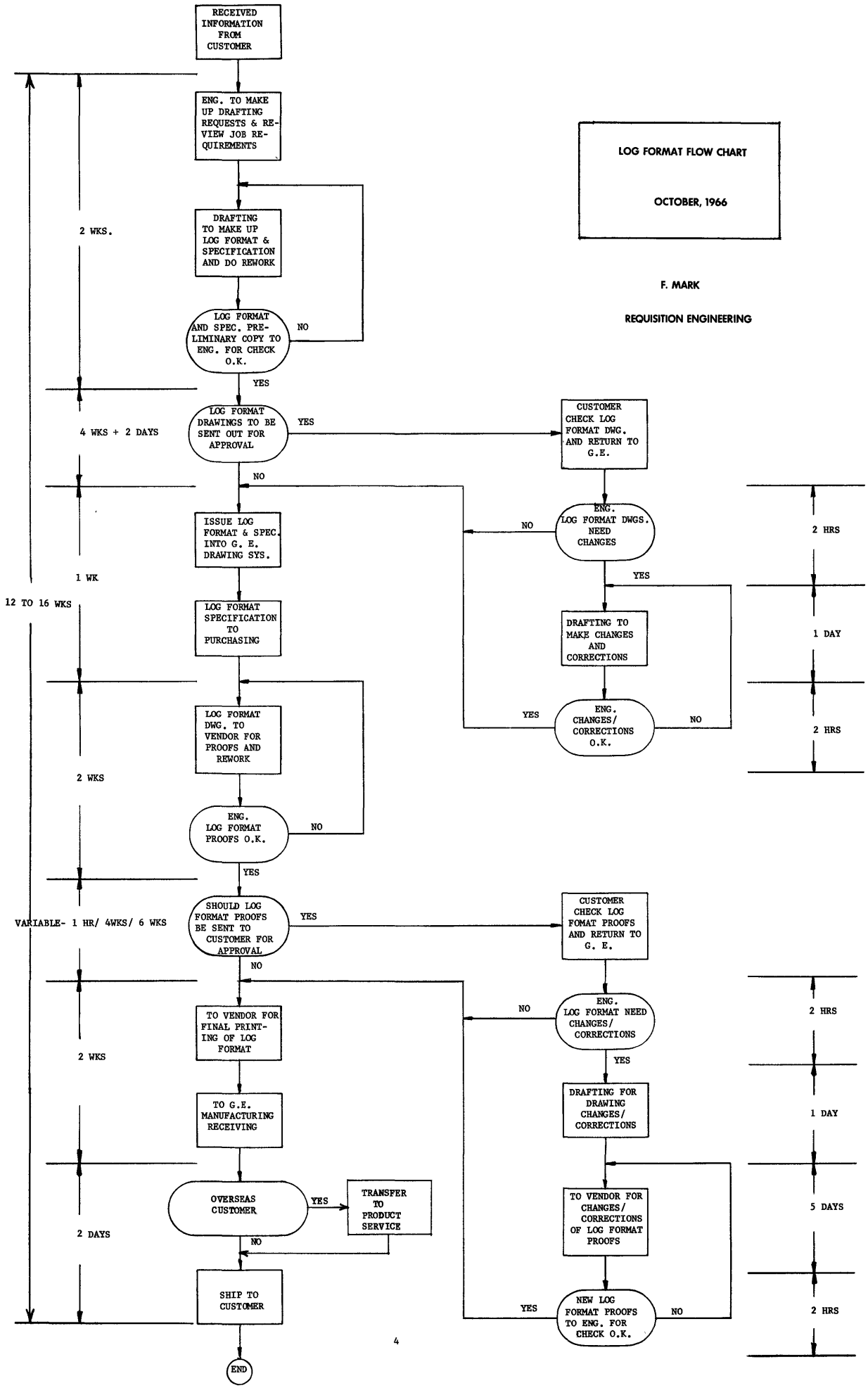
After the vendor sends the proofs to requisition engineering at PCBS, they are checked over and submitted to the customer for approval. If no extensive changes are necessary, this takes from four to six weeks. Changes require more time.

With the approved log format proofs in hand, requisition engineering is ready to have the format paper printed. Printing normally requires two weeks. However, if the paper is 21-1/2 inches wide, an additional four weeks are required as the printing must be done in another state.

Total time required is from 12 to 16 weeks. Much detailed preparation is required for what may seem to be a relatively minor phase of the GE/PAC order.

Questions regarding log sheet format information should be addressed to F. M. Mark, requisition engineering, PCBS.

SEE PAGE FOUR FOR PRODUCTION PROCESS



LOG FORMAT FLOW CHART

OCTOBER, 1966

F. MARK

REQUISITION ENGINEERING

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 38
November 30, 1966
Randall H. Larson, Editor

NEWSLETTER

PCBS POURS CARE INTO CEMENT PROJECT

CIMENTS LA FARGE GETS PERSONAL TOUCH

General Electric is the company who CARES! Case-in-point-department: the effort recently poured into the Ciments La Farge project in France.

Last May, PCBS began the installation of a twin GE/PAC 4040 system at the Ciments La Farge cement plant near Lyon, France. During August and September a stroke of bad luck befell the project, however, as the drum memory went into an unaccountable decline. On October 7, the decision was made to replace the drum.

Replacement of a drum memory is no simple task in itself, and the task is not facilitated by 10,000 miles between the installation and the source of supply.

PCBS Manufacturing and Quality Control immediately began efforts to locate and begin testing a suitable replacement. Product Service and IGE went to work organizing transportation and export facilitation for the shipment.

The replacement drum completed test by late afternoon October 8 after Burl Steele, PCBS Quality Control, worked through three successive nights helping to rush the job. Bud Merritt and Bill McCardie, both of PCBS Product Service, packed the drum and took it to the Phoenix Airport by automobile. Red O'Hara, IGE requisition engineer, personally met the plane in New York and helped to speed customs processing. By Sunday morning the drum was on its way to Paris, where it was again met by IGE personnel who transferred it to a truck to be driven to the small village of Lozanne, near Lyon.

By noon Tuesday, October 11, the new drum was installed and running. The complete job of locating, testing, shipping and installing the replacement drum had been completed in only a little over 88 hours.

Not long after, the following telegram signed by Lonnie Sundal, Dick Pecora, and Jerry Samstad, GETSCO, was received by David Hamilton, PCBS application engineer:

> "We have received our replacement drum here at Val d Azergues. We have it installed and it is working perfectly. I feel that a record must have been set regarding customer service during this past week. Only five days elapsed from the time that we decided that we needed a new drum until it arrived at the project site here in France. Our thanks here go out to each and every person who had a part in this remarquable (sic) display of teamwork."

The Ciments La Farge cement plant project represents a critical entry into a newly developing European market. The kind of service narrated above is the kind of CARE General Electric hopes will set in the minds of potential European customers.

GENERAL ELECTRIC CONTRACTS

TO DEVELOP

PROCESS OPTIMIZATION SYSTEM

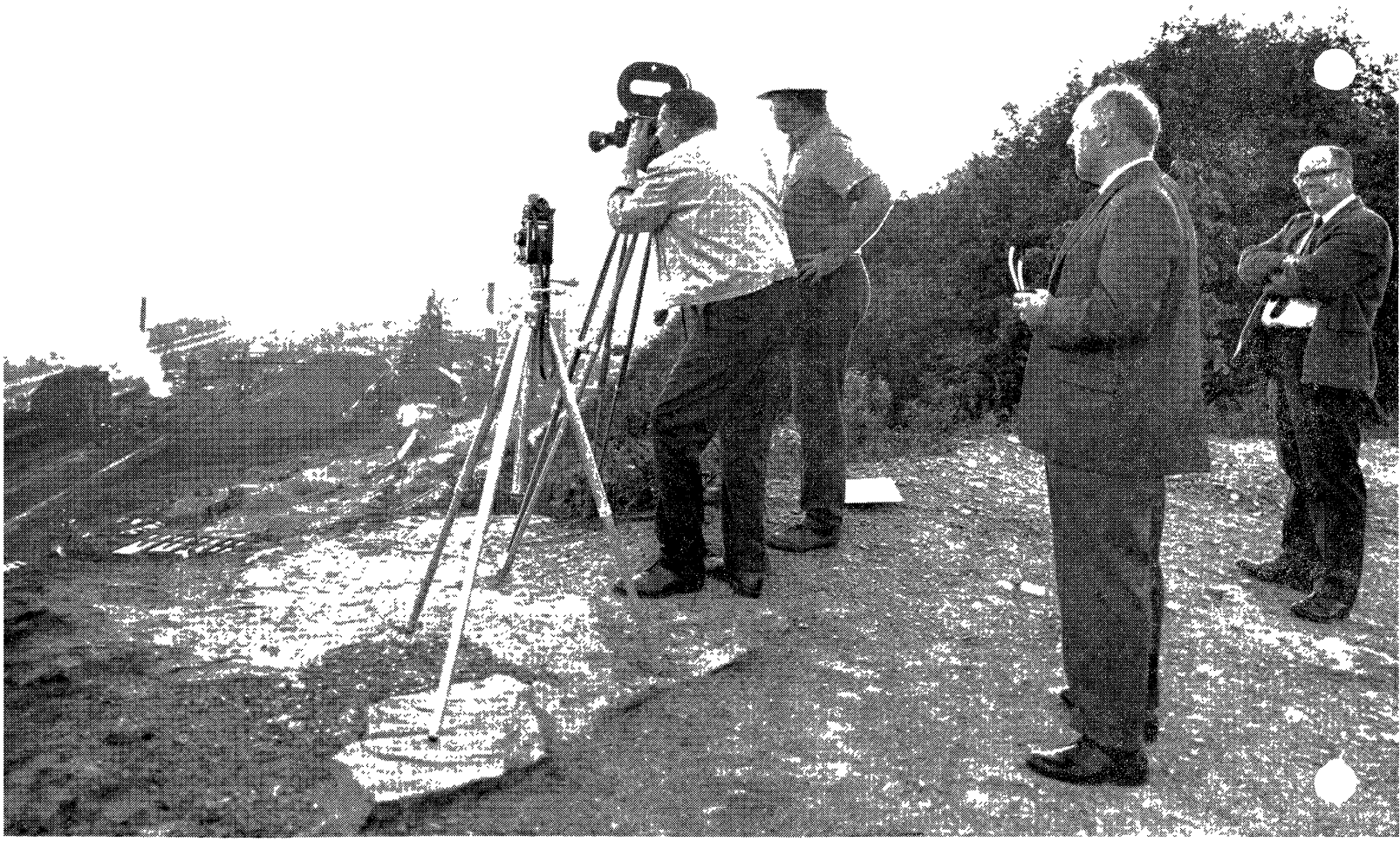
General Electric has contracted with Bonner & Moore Associates, Inc., Houston consultants in computing technology and management sciences, to develop an on-line* process optimization system for use with GE/PAC* 4000 computers.

The new software system consists of a set of functional programs, making use of linear programming techniques to perform standardized non-linear optimization procedures. It is scheduled to be available in the fourth quarter of this year.

The new on-line process optimization system is primarily designed to operate in conjunction with user-written programs for real-time process control and monitoring. It may also be used in off-line applications for experimentation, verification and acquisition of management information.

Because the new optimization system can be integrated with General Electric's real-time monitor system, it can make use of the free-time capability of GE/PAC 4000 computers to optimize several process units concurrently, to simultaneously maintain several models for each unit or to provide facilities for building and modifying simulation models in a system.

*Registered Trademark of General Electric Company



R. F. Hogate, foreground, head of Advertising and Sales Promotion at PCBS, oversees shooting of scene from "The Competitive Edge," forthcoming GE/PAC promotion film. You will want to see this film shown at your neighborhood industries. Release date, set for December, 1966, will be announced in a future issue of the NEWSLETTER.

ADVANCE RESERVATIONS

WILL INSURE CUSTOMERS

A PLACE IN THE SUN

Seating in our customer area is at a premium and is reserved on a "first-come, first-served" basis. To better accommodate visitors expecting to stay in Phoenix for a few days, weeks, or months, please contact your PCBS sales engineer with details on the visit.

Customers have been coming to Phoenix in increasing numbers all this year to visit our operation, attend classes, observe their system or check on its progress, or to remain and do programming on the system prior to delivery. Their presence at the Process Computer Business Section is a part of our way of life and we must do our best to meet their needs once they have arrived.

With your cooperation we can arrange to have the welcome mat out for visitors. Please give us plenty of advance notice of their visit.

To better serve your reservation needs when you plan to come to Phoenix, or send a customer of yours, please call our receptionist (Dial Comm 8*434-5321) for assistance. In the past, various individuals have handled these arrangements for you. Our expanding activities now dictate that to better serve you we should have a central point to provide this service.

Remember, Phoenix is a resort town in the winter months and the rush is already on for accommodations. Make your plans and reservations early.

CORRECTION NOTED

One correction should be noted in regard to the article on log sheet data which appeared in the last NEWSLETTER. The second paragraph should read:

When the Process Computer Business Section is under contract to provide a year's supply of log sheets with a GE/PAC order, it is vitally important that this information be correct and submitted on time! It is necessary to design each one individually and produce each one by hand. Proper time limits must therefore be observed.

PROGRAMMING, PRODUCT SERVICE

CLASS SCHEDULES NOW AVAILABLE

Class schedule and information bulletins for both Programming and Product Service training programs are now available. The Process Computer Business Section program for training process industries personnel in the fundamentals of process computers is expanded over past offerings. The courses are open to personnel of companies beyond these which have purchased G-E computer equipment.

These bulletins should be ordered directly from Advertising and Sales Promotion, Process Computer Business Section, P. O. Box 2918, Phoenix, Arizona 85002. To further facilitate your orders for General Electric literature, the ordering instructions which appeared in the last NEWSLETTER reappear below.

All publications with the designation letters "GE" or "IPC" can be ordered from the Advertising and Sales Promotion Distribution Center in Schenectady.

Publications covering business computers such as The Compatibles 400 and 600, the GE 200 series, and the GE 115 are prefixed "CPB" and should be ordered directly from the General Electric Information Systems Marketing Operation, Publications Distribution (Bell Road), P. O. Box 270, Phoenix, Arizona 85003.

For publications bearing a "PCP" number, write directly to Advertising and Sales Promotion, Process Computer Business Section, P. O. Box 2918, Phoenix, Arizona 85002.

COURSE FILLED

The January 9th Customer Programming Training Course is full. We have enrolled as many people as the physical facilities permit.

There are still plenty of openings in the next course, which begins on February 13. Please make every effort to get your customers to take that course or a later one, rather than forcing themselves into the January 9th course.

TELETYPE 35 ASR UNIT REPLACES FLEXOWRITER

The Teletype 35 ASR unit is now equipped with all necessary functions to perform off-line paper tape preparation and verification. The Friden flexowriter is now unnecessary in the GE/PAC line and will be replaced in the price book by an off-line Teletype 35 ASR at a lower price. While the on-line console 35 ASR precludes the need for the off-line version, some customers may desire a second one. The advantage here is that the off-line unit can also provide the function of a standby spare for the on-line unit. The Teletype Model 33 ASR is not a good off-line tape preparation device because it does not provide certain functions such as recognition of the delete code.

NEW MAINTENANCE INSTRUCTIONS

TO REACH

ALL SPECIALISTS, DATA BOOK HOLDERS

New instructions covering all types of maintenance services provided by PCBS will soon be distributed to all data book holders and specialists. These instructions should clarify any questions regarding maintenance service arrangements. Included is a new class of service, Class II-A, Fixed Price Maintenance and Variable Price Maintenance.

Early copies may be obtained from Murray Burger, Product Service, Process Computer Business Section, P. O. Box 2918, Phoenix, Arizona, 85002.

Find attached to this NEWSLETTER latest PCBS Marketing Directory.

GE/PAC 4000 PRIMER

GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

GENERAL ELECTRIC COMPUTER INPUT

In 1952 the GE Industrial Computer Section was formed in Syracuse. For the next four or five years this Section was primarily concerned with the design of special purpose machines to do very special jobs. April 1956 marks the beginning of a separate business activity which could be called a computer department. At this point GE secured an order from the Bank of America for a complete computer system. The Bank of America had devoted five years and $2,000,000 to a research study with the Stanford (University) Research Institute. The GE order, which is still one of the largest computer orders ever placed, is a tribute to alert salesmanship since it was secured against a field of nearly 20 competitors. Out of this $50,000,000 contract for over 30 individual computers came a machine called ERMA (Electronic Recording Method of Accounting) and Magnetic Ink Character Recognition (those funny-looking numbers at the bottom of your checks). From 1959 through 1962, GE built the central processor portion of the NCR 304. These machines have a 6-bit binary-coded decimal (BCD) character and ten characters per word. The memory is magnetic core. About 30 of these computers were built. The General Electric Company secured its first order for what is known today as a process computer from the Southern California Edison Company, Los Angeles, California, in 1958. Since that time, more than 230 process computers have been ordered from General Electric to satisfy a variety of customers and applications.

The first GE process computer system was installed in 1960 at Huntington Beach #3 Station of the Southern California Edison Company. The machine supplied was a GE 312 computer capable of scanning, logging, alarming, and control utilizing the process sensor signals from the main plant and its auxiliaries.

Two generations of process computers have evolved since the GE 312 of 1958. In 1961, the GE 412 was announced. This computer is very similar to the highly successful GE 225 business computer which was announced about the same time. The 412 was more reliable, provided more accurate and versatile control, and performed calculations approximately three times faster than its predecessor. In 1963 the first GE/PAC 4000 was announced. The GE/PAC 4000 series now consists of four models -- GE/PAC 4040, 4050, 4060 and 4020. The GE/PAC machines can calculate and control at speeds two to ten times faster than the GE 412. The GE/PAC 4020 might be considered an additional "half-generation" because of its extensive use of monolithic integrated circuits and new packaging technique.

In February, 1961, the Process Computer Section was formed and separated from the then Computer Department. While the new Section remained in Phoenix, Arizona, it was assigned to the Industry Control Department.

January 1, 1966, the name was changed to the Process Computer Business Section and became a part of the Information Systems Division. On September 1 it was placed in the newly-created Industrial Process Control Division.

In mid-1965 four regional engineering/programming offices were established in Atlanta, Cleveland, Houston, and Reseda, California. Early in 1966 all elements of PCBS in Phoenix were brought under one roof when floor space at the original plant site was more than doubled.

General Electric is a major supplier of process-control computers. Briefly outlined below are the functions being performed by the process computer in its major market area as of the end of 1965.

The utility market comprises better than 25% of the total market. Typical applications include steam plant calculations, boiler-turbine-generator control, and load dispatching. About one-third of these are closed-loop systems with the balance being primarily data loggers.

The steel industry makes up about 25% of the overall market. Typical applications within this area include complete hot strip mill automation, basic oxygen furnace control, and tandem cold mill set up and scheduling. In steel, about two-thirds of the systems are closed-loop operations.

The petroleum and chemical industries comprise another 25% of the total market. Typical applications include process monitoring and optimization, refinery dispatching, and catalytic cracker monitoring. Very few of these systems operate closed-loop.

The remaining 25% of the market includes all other industries. Of particular importance is kiln control for cement mills, railroad classification yards, atomic reactor monitoring. G.E. has traditionally been strong in the utility and steel markets. A major supplier to the petroleum and chemical segment of the market, Bunker-Ramo, recently departed from the process computer business with many of their employees and much of their know-how moving to G.E.

A tabulation of installations or detailed applications is difficult. It is hard to distinguish between data loggers and true computers. In many cases the data logger may actually be just a fancy recording device. In any case, it would appear that there were about 500 process computer systems installed as of the end of 1965. About 75% of these systems are located in the U. S.

The Process Computer Business Section is one of two General Electric computer-producing facilities in Phoenix. Because both are located in Phoenix, they are often confused or thought of as one. Though to some extent the two computer operations serve the same markets, they are in different divisions within the General Electric Company and have different marketing channels. The primary marketing channels for GE/PAC process computers are the Industrial Sales Division, Electric Utility Sales Division and the International General Electric Company.

The business computers (GE 115, 200, 400 and 600 series) are marketed by the Information Systems Marketing Operation except for a few specifically assigned accounts in basic industries.

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 39
December 21, 1966
Randall H. Larson, Editor

NEWSLETTER

IRS PLACES ORDER FOR 4060 HARDWARE

The Internal Revenue Service recently placed an order for a computer system including a GE/PAC 4060 central processor.

The system, which also includes a disc storage unit, magnetic tape units, a DATANET-760 utilizing visual display remote terminals, is expected to save substantial space and manpower requirements compared to the present card punching and verifying system now used by the IRS to process tax returns.

Installation of the complete system, which will operate on a pilot basis, will be early next year at the Southeast Regional Office in Atlanta. Depending on the success of the pilot installation, similar systems may be installed in all seven IRS regional centers.

Requests for bids on the new data transcription system were issued in December, 1965, to 60 companies in the data processing field. Of ten proposals received, the General Electric proposal, submitted by the Federal Systems Operation, was selected for the trial installation.

CHECK CUSTOMER'S EQUIPMENT WHEN PROMOTING COMPILING, ASSEMBLING COMPATABILITY

When promoting the virtures of compiling and assembling GE/PAC functional programs on the various GE 225's at G-E Information Processing Centers around the country, be careful! There are only five IPC's that are capable of punching ASCII paper tape. They are: Phoenix, Chicago, New York, Cleveland and Washington. The 4202 buffer in the GE/PAC's require 8-channel, even parity characters (Straight Transfer Mode). If your customer owns or has access to a GE 225 on which he plans to compile and assemble functional programs, he should plan to include a card reader as an input device on his GE/PAC system if the GE/PAC has a model 4202 buffer, or the GE 225 has a paper tape punch with Straight Transfer Mode operation.

NEW COMPUTER PROGRAM VIRTUALLY ELIMINATES MACHINE ERRORS

CHANTS PUT CLAMP ON COMPUTER CAPERS

Spokesmen for a local electronics firm this week announced a digital computer program that - through fresh application of an old technique - virtually eliminates lost time due to malfunction of computer components. Called OREMA (oh-RAY-ma, from the Latin oremus, meaning "let us pray"), the program offers prayers at selected time intervals for the continued integrity of memory units, tape transports, and other elements subject to depravity.

Basically liturgical in structure, OREMA uses standard petitions and intercessions stored on magnetic file-tapes in Latin, Hebrew, and FORTRAN. It holds regular Maintenance Services thrice daily on an automatic cycle, and operator intervention is required only for mounting file-tapes and making responses, such as "And with thy spirit", on the console typewriter.

Prayers in Hebrew and FORTRAN are offered directly to the Central Processing Unit, but Latin prayers may go to the peripheral equipment for transfer to the Central Processor by internal subroutines.

Although manufacturer-supplied prayer reels cover all machine troubles known today, the program will add punched card prayers to any file-tape, as needed, after the final existing Amen block. Classified prayer reels are available for government installations.

In trials on selected machines, OREMA reduced by 98.2 per cent the average down time due to component failure. The manufacturer's spokesmen emphasized, however, that OREMA presently defends only against malfunctions of hardware. Requestor errors and other human blunders will continue unchecked until completion of a later version, to be called SIN-OREMA.

The above contribution to computer knowledge comes to us from Fred Schempf, ISD, Milwaukee, where the paper industry is a primary target for GE/PAC salesmen. We understand his office is churning out a lot of pulp similar to this. With a system like this working, a paper mill ought to make a dandy roll.

Ed.

GENERAL ELECTRIC

GE/PAC 4000
GENERAL ELECTRIC PROCESS AUTOMATION COMPUTER

AN INVENTORY OF GE/PAC IN PRINT

The end of the year signals inventory time. Below is a compilation of GE/PAC brochures and manuals now available from PCBS. The list should help you to take inventory of your current GE/PAC literature. A concise description is included with each publication.

There is, of course, a catch to ordering these publications. You must sell a GE/PAC system!

"WHAT'S A PROCESS COMPUTER?" (GEA-7260B) This heavily illustrated brochure consists of a series of relevant questions and answers describing the unique role of the process control computer in industrial automation, its features and capabilities, its function, where and how it is used, and how the process control computer differs from its general purpose counterpart.

PROCESS COMPUTER CONCEPT COURSE - A general overview of computer science and technology: introduction to process control computers, application and justification for control computers, the digital computer, on-line system inputs and outputs, basic programming structure, concepts of programming, concepts of real-time programming. Suitable for the technically trained. To be used as an outline for presentation. Not textual or self-teaching.

GLOSSARY OF PROCESS COMPUTER TERMS (GET-3397B) A handy dictionary for use in understanding the special language of computers.

GE/PAC 4020 COMPACT COMPUTER FOR PROCESS CONTROL (GEA-7272A) A 12-page brochure with illustrations, containing specifications, and descriptive material on the 4020, and text on how to begin installation of a completely automated plant.

GE/PAC FREE-TIME SYSTEM (GEA-7288) A descriptive brochure designed for customers, this four-page piece tells how to attain the highest utilization of a GE/PAC computer.

GE/PAC 4000 PRODUCTION MANAGEMENT COMPUTER SYSTEM (GEA-8464) A four-page brochure describing the benefits and techniques of a computer system applied to discrete item manufacturing.

STEAM ELECTRIC EVALUATING AND RECORDING SYSTEM (GEA-8465) A recently published six-page fold-out describing a new system concept in monitoring steam plant performance. The system can be designed into a new steam plant or can be applied to an existing one to achieve improved turbine efficiency and better planned maintenance.

SOFTWARE FOR THE GE/PAC 4000 (GEA-8021A) An eight-page brochure describing the GE/PAC line of available software, including program preparation aids, standard on-line functions, and debugging aids.

GE/PAC 4060 (GEA-8061A) The descriptive brochure on the GE/PAC 4060 and what it can do. Highly illustrated.

GE/PAC 4000 SYSTEMS MANUAL (GET-3201B) The detailed, technical manual of the GE/PAC 4000 system, including a general description, chapters on the central processor, process communications, man communications, programming features of GE/PAC 4000, the instruction list, GE/PAC software, domestic maintenance service, and general process computer services.

GE/PAC 4000 PROGRAMMING MANUAL (PCP-102B) The detailed, technical manual of the GE/PAC 4000 software and its implementation. Includes general system description, chapters on the GE/PAC 4040 system, the GE/PAC 4050-4060 system, data manipulation, program control, input and output control, data communication, process communication, man communication, and the GE/PAC programmer's console. An octal decimal conversion table, a flow chart systole, and a GE/PAC instruction summary are also included.

Also pertinent is SYSTEMS SIMULATION FACILITY, (GEA-8028). This brochure, put out by the Industrial Systems and Engineering Operation, Schenectady, New York, presents G-E competence and experience in developing mathematical models and simulating industrial processes for studying control problems.

Wishing you a Merry Christmas...

...and a Happy New Year

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 40
January 30, 1967
Randall H. Larson, Editor

NEWSLETTER

NEW PRICE BOOK BECOMES EFFECTIVE WITH NEW YEAR

PRICE BOOK 11 SETS GENERAL PRICE INCREASE OF ABOUT FIVE PER CENT

The latest PCBS prices, Price Book 11, will soon be distributed as Section 8702 of the Apparatus Handbook. Advance copies were sent to all process computer specialists before the new year.

The new prices represent a general increase of about five per cent for a typical process computer system. However, whereas some prices are higher, others are lower than previous rates.

The general increase is necessitated by the continued rise in the costs of labor, both professional and production, and by the mounting special engineering, programming and system analysis essential in the newer systems.

Effective date for the new prices was December 30, 1966. All new quotations which were made on or after December 30, 1966 must be based on the new price book. Any quotations outstanding as of December 30, 1966, will be honored at the then prevailing prices provided the requisition was booked no later than January 19 ,1967, and the other terms and conditions are acceptable when these contracts became fully executed. All other quotations must be requoted at the new level.

Prices on existing rental contracts will be adjusted to the new levels at the expiration of the 12-month rental period.

Several new peripherals are listed. Among them are one-and two million word disc storage files and card readers which handle 100, 200, or 300 cards per minute. Availability of higher performance buffered input/output memory channels for the GE/PAC 4020 central processor were also announced.

Some superseded peripherals are the NCR 70-cards per minute card reader (Model 4240), the Elliott 300-cards per minute card reader (model 4240A2), the Data Disc 250 K disc memory (Model 4540) and the DS 150 and 250 disc storage units. The Data Edit 750 is discontinued.

In addition, prices and availability of standard prints and instruction books, and standard on-site check-out procedures are listed.

Also included in the price book is an itemized pricing schedule for the various maintenance services available.

DEWEY PORTLAND SYSTEM FOUND TO BE 'A SOLID MACHINE'

Those close to any business usually find themselves forever surrounded by problems and more problems but seldom uncover any of the rewards they are working for.

However, all labors have their rewards, and producing process computers is no exception. Witness the comments of Jim Lane, PCBS process analyst, speaking of the Dewey Portland installation: "The computer operation can best be described with one word — wonderful! It is such a pleasure to work with a solid machine. We have not had a single computer failure in the three weeks that I have been here."

Refreshing? Rather. This is the kind of comment we like to hear more of at PCBS. Does the system use OREMA tapes, Jim?

McNULTY WINS AWARD

John McNulty, process computer specialist in Cincinnati, recently received an Industrial Author Award. The presentation was made in Phoenix by Bud Hogate, PCBS Advertising and Sales Promotion. The personalized desk pen set, awarded by the Industry Control Department, is in recognition of two articles written by McNulty while working in Salem, Virginia. "Modern Control for Adjustable Voltage DC Material Handling and Process Drives" was printed in Iron & Steel Daily News and "Industry's Challenge for Profits" will appear in "33" magazine.

HOT LINE 8-434-5500

THE NUMBER is changed, but nothing else is. The Process Computer Marketing "Hot Line," an effective means of reaching PCBS Marketing personnel when you need them most, continues operation under a new number 8-434-5500. The procedure remains unchanged, however. If a busy signal is reached when dialing a member of the PCBS Marketing force, simply dial the Hot Line and ask the secretary to have your call returned by the person you are trying to reach. You give her only your name and telephone number. Calls on this line should take a maximum of 30 seconds. Therefore, if this line is busy, you should find it open very shortly.

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 41
March 10, 1967
Randall H. Larson, Editor

NEWSLETTER

PROCESS COMPUTER SPECIALISTS GATHER FOR ANNUAL SALES SEMINAR

See story on pages 2 and 3.

GENERAL ELECTRIC

PROCESS COMPUTER SPECIALISTS GATHER

It was the last of January, the East was suffering record blizzards, the North was digging out, the West Coast was afloat, and other parts of the nation were chipping loose.

General Electric process computer specialists found it an ideal time to gather in Arizona's Valley of the Sun for the first annual Process Computer Business Seminar.

The seminar, January 25 – 31, provided a week-long refresher course in process computer marketing and technology for process computer specialists from throughout the United States and even Europe and South America. Including PCBS personnel, nearly a hundred gathered at the Wigwam, a desert oasis in Litchfield Park, Arizona, about 15 miles from Phoenix.

But the program was not all dinner-by-the-pool. Attendees went behind closed conference room doors to absorb five and a half long days of speeches, lectures, and panel discussions, most of them illustrated and followed by lengthy question-and-answer periods covering all aspects of the process computer market and the General Electric process computer product.

Carl Raine, PCBS Marketing Manager, opened the meetings with introductory comments in which he related the seminar's objectives and gave a brief resume of the present management philosophy regarding markets, regions, lease and purchase agreements and other matters.

Then detailed technical discussions began in earnest. The almost continuous discussions following for the rest of the week were devoted to product planning orientation, a 4020 overview, the software directory and software technicalities, a thorough briefing of competitive designs, product service plans, Project's organization and function, and internal procedures.

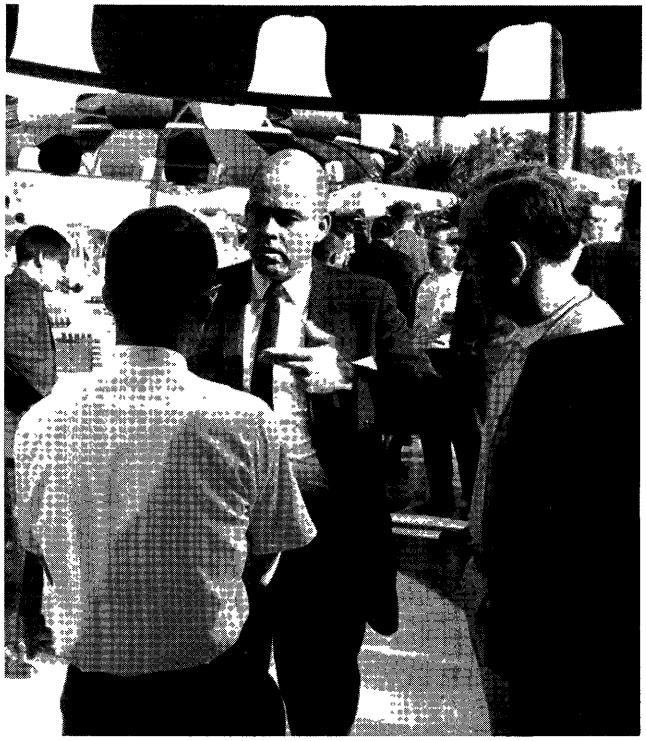
For a half a day Saturday specialists heard a detailed report on the new Price Book 11. Then all headed for a day and a half of golf, relaxed informal discussions, or just Sun.

On Monday morning the seminar resumed with explanations covering the functions of the newly formed Marketing Support Services. Later in the day, the new PCBS film, "The Competitive Edge," made its debut.

Details of sales plans for specific markets were covered in smaller discussion groups on Monday afternoon and Tuesday morning.

Armed with looseleaf notebooks bulging with speech transcriptions, charts, graphs, brochures and other printed matter, the specialists returned to their respective sales offices. But they returned with the assurance and confidence of having attended the first really comprehensive and concentrated process computer business seminar.

The seminar had been at once both a state-of-the art and a state-of-the-business presentation which enabled all attending to become thoroughly immersed in process computer marketing and technology.



I DON'T CARE WHAT HE CALLED YOU, WE DON'T PUSH PEOPLE INTO THE POOL.

John McNulty, process computer specialist from Cincinnatti, right, receives Checkmate graduation certificate from Carl Raine.

A FEW SCENES FROM THE FIRST ANNUAL PROCESS COMPUTER BUSINESS SEMINAR

On Thursday evening the specialists bussed over to the PCBS plant for a tour and 4020 demonstration. Stay awake, Bob.

More good word on the results of General Electric process computer installations has been received from the field! To be exact, three good words.

Item One: Richard A. Grant, president of California Portland Cement Company, recently wrote a letter to President Borch in which he commented that "Our GE computer continues to perform most satisfactorily and with new accomplishments regularly."

Item Two: A telegram from Brian Barker, PCBS, and Shelly Swigart, IGE, both presently in Tokyo with the Anegaski installation, states: "Tokyo Electric Power Company Anegasaki installation is going smoothly. Central processor runs exceptionally well. Have run AU-1 and AU-2 'instruction test' two nights without fail. Worse case core test with comparison ran over weekend without problem. All peripheral equipment checked out fine but have not checked multiple output controller to consoles this date. Will test drum as soon as mounting hardware arrive. Problem in sequence was due to short incabling. Give my regards to QC and Preship for a job well done."

Item Three: A major chemical company has received its fourth process computer. Rodger Knaus, district sales manager in St. Louis, writes, "We. . .are in better shape on Machine 'A' than it looked like we were going to be in the last few weeks. I just want to say how much we here personally appreciate your performance and your interest in this customer. Thanks a great deal."

4020 SYSTEMS MANUAL

Please note the following in the revised version of the GE/PAC 4020 Systems Manual. On the first page of the configuration chart (II-2), there should not be a 4026 Floating Point Module included. This component is NOT available with the 4020 central processor.

Two PCBS employees, Sherril A. Harmon, left, engineering, and Robert G. Erickson, right, programing, discuss with PCBS manager R. C. Berendsen the patent application for which they recently received a Company patent award in recognition of their contribution to General Electric technological progress. The patent application covered an invention incorporated in the GE/PAC 4060 central processor. Harmon's award is for his ninth patent application.

PROCESS COMPUTER
BUSINESS SECTION

P. O. Box 2918 • Phoenix, Arizona 85002

Number 42
March 17, 1967
Randall H. Larson, Editor

NEWSLETTER

EXPANDING PCBS GETS NEW LOOK

In the past few weeks, PCBS has turned itself inside-out to improve its service to customers. The dust is still settling after a succession of organizational upheavals which have left very little unchanged. Almost overnight entire offices moved to other parts of the building--or out of the building completely. Walls appeared here and disappeared there. New doorways were cut while some old ones were filled in.

But the reorganization and expansion were only the latest in a continuing series necessitated by the increasing number of process computer orders. Less than a year after moving its complete operation under the single roof of the expanded Desert Cove Road plant, PCBS became too cramped for efficient operation and possessed no room for expansion of the mushrooming business.

Marketing Manager Carl Raine announced reorganization in January. Ten managers reporting to him were reduced to seven. Notably, Application Engineering, as an operation, was eliminated. Application engineers were absorbed into appropriate sales functions. Paper and Textile Sales Development was consolidated with Industrial Sales. Process Analysis became a part of Process Sales. Its former manager, Willem Brand, became a consultant to Carl Raine and now works in Marketing Support Services, a new component managed by Ed King, who was formerly in Application Engineering. Marketing Support Services also includes Training and Technical Services, Advertising and Sales Promotion, and Licensee Support. Product Planning and Marketing Research now goes under the new title of Business and Product Planning, reflecting a change in its scope.

First, Product Service moved en masse into newly rented space at 19th Avenue and Desert Cove Road, only a few blocks from PCBS headquarters. The building is now also the quarters for Special Systems Engineering and visiting customer engineers and programmers.

Other marketing and engineering components moved quickly into the vacuums provided by the above departures. Employees temporarily groped for their new places and consulted floor plans. Fortunately, difficulty in making phone call connections lasted only a few days. Each area's communication was back to normal and order had been restored very shortly.

For those who did experience inconvience in doing business with PCBS for the brief period, our apologies. But we think we are now better organized and better fitted to function efficiently and to provide better service to our customers. The move allows far greater space and accommodates the latest organizational changes.

4201B BUFFER REPLACED ON 4040/50/60 SYSTEMS

All 4040/50/60 computers on systems releases are now to be sold using only the 4202B buffer. This unit replaces the 4201B buffer.

Any 4040/50/60 systems recently sold with the 4201B buffer should be reviewed for possible change to the 4202B buffer. It will be possible to provide a 4201B buffer if a specific system requires it. For example remote scanners will continue to require the 4201B for remote peripherals.

The 4020 systems are not affected by this change.

ASME CONTRIBUTION RECEIVES NOTICE

The Technical Briefs section of Power magazine recently featured a full-page discussion of "Evolution in Computer Control of Steam Power Plants," an ASME Winter Meeting paper presented by Frank L. Battuello, PCBS manager of Power Plant Computer Sales and Applications.

His paper was chosen from more than 400 presented at the conference to open the first of three Technical Briefs sections devoted to the ASME Winter Meeting.

Such prominent display of Mr. Battuello's contribution is a compliment to the author, and reflects on General Electric, as well. There are two basic reasons for the fortunate attention given his work.

First, the paper is well written and objective, and discusses a subject which is of vital interest to the industry. As the editors comment in their discussion of the paper, "...questions rhetorically posed by the author are discussed in comprehensive fashion: the paper is a valuable one for all engineers affected by by the growing importance of power plant automation."

Second, the paper was prepared well in advance of the meeting, when the greatest consideration could be given it, and submitted to the magazine in ample time to be evaluated for publication.

When future technical papers are prepared for presentation, the above points should be remembered for the broadest possible additional exposure in the trade press.

WHO'S AFRAID OF '67 AND WHY?

IRON AGE EDITORS INDICATE HOT, COLD MARKET FOR COMPUTER SALES

The attitude of metalworking managers toward 1967 might best be described as *nervous*. The present solid state and future uncertainty of the industry is enough to give anyone the jumps.

On one hand, companies are straining against bulging backlogs, manpower shortages and delivery delays. On the other palm, they read signs of higher taxes, tighter money, and the petering out of the capital goods boom.

Generalities about the future *do not* check out with the realities of the present. And the best laid plans of forecasters are all hedged by the big unknown quantity: The war in Vietnam. A stepup could blow the lid off the metalworking and metal-producing industry. A cease fire or some sort of accommodation to lessen the ferocity of the struggle could bring waves of equipment *cancellations*.

For this reason, some companies in the industry are preparing two budgets for 1967, and in some cases three. The budgets are based on these premises: The war will continue pretty much at the same level; It will inflate; It will diminish. There is no reason right now to believe that *any one* of the three has more substance than the others.

THE 1967 TAX BITE

Tax increase or no tax increase, industry will be *forking more over in 1967*. The reasons: The stepped up pay-as-you-go plan that went into effect in 1966; the high level of profits generally throughout the metalworking industry this year; tight money.

Because of the shortage of money in 1966, numerous companies took advantage of the ruling that allows companies to move part of their taxes into the *following* year. Many did. The result: More money will leave corporate treasuries in 1967. This will bring on higher tax bills whether an increase is voted *or not*. As far as a business tax increase is concerned, analysts say, if one comes, it will average out at about *three percent*.

Added to the higher taxes caused by postponements, there is the loss of the seven percent investment tax credit. This, too, will take its toll on company coffers.

Because of the bigger tax bite from present or future quarters, business advisors are warning clients to beef up cash contingency funds to take care of unexpected costs of doing business in 1967.

This *can't help* but have an effect on *dividends* in the coming year. And the stock market is reflecting it. It is a *partial* explanation of the depressed state of stocks in the midst of elated earnings reports.

The suspension of the seven percent investment tax credit will have an effect on capital goods spending. *Just how much* is something else again.

Higher defense needs could keep companies in the capital goods market, tax credit or no tax credit. Also the provisions that have been worked into the bill suspending the credit will lessen its effects.

For example, the credit can *still* be used if building construction was underway at the suspension date even though equipment had not yet been ordered to fill it. Then there is the matter of applying the credit to those orders that can be reopened due to escalation clauses and the like. In sum, the *provisions added* to the suspension bill *will lessen* its impact.

JUST HOW GOOD IS BUSINESS?

Despite all the hand wringing and uncertainties facing metalworking in 1967, the industry is now doing *very well.*

The plants in the industry are operating at over 90 percent of capacity. And figures over the years show that when the capacity of the industry passed the 80 percent mark, manufacturing plants buy equipment heavily, especially machine tools.

NEW MARKETS IN EASTERN EUROPE

Since the U.S. government is committed to opening up East-West trade to improve relations with these groups, it now looks like *more* machine tool companies here will be doing more business behind the Iron Curtain.

This has been standard practice for countries in the West for some years. British, German, French, Italian and Swiss makers have *actively* sought the business. Great Britain, with some 30 percent of its machine tool output going for export, expects to push for *even higher* sales in 1967.

U. S. machine tool exports have been a *considerable* part of the industry's business *for some time*. This year over *$125 million* worth of machine tools will be *produced* for export. *New orders* for foreign shipments this year will come to $175 million.

From 1960 to 1965, one out of every five U.S.-made machine tools went for export. The dollar total comes to over one billion.

The demand for U.S.-made tools abroad will *increase* with the opening of trade with Eastern Europe. To stimulate it further, the Commerce Department is *loosening up the strings* on export control licenses. This trade with Eastern Europe could come at a time when the capital goods market in the *U. S. tapers off.*