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ESTIMATING AND BIDDING FOR THE SPACE STATION PROCESSING FACILITY

OR

IN-81-TM 190597

SPACE STATION PROCESSING FACILITY GOVERNMENT ESTIMATING

OR

AEROSPACE PRICE BOOK - VOLUME IV

OR

HOW THE GOVERNMENT ESTIMATING WAS SO ACCURATE

OR

HOW THE LOW BIDDER GOT LOW ON SSPF

FOR

AACE INTERNATIONAL 37TH ANNUAL MEETING

DEARBORN, MICHIGAN

JULY 11 - 14, 1993

BY

JOSEPH A. BROWN, CCE

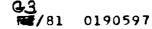
SENIOR ADVISOR AND COORDINATOR FOR DEVELOPMENT OF COST ENGINEERING AND ESTIMATES

DF-FED

KENNEDY SPACE CENTER, FL 32899-0001

(NASA-TM-109323) ESTIMATING AND BIDDING FOR THE SPACE STATION PROCESSING FACILITY (NASA) 29 p N94-15546

Unclas



Estimating and Bidding for the Space Station Processing Facility

by

Joseph A. Brown, CCE DF-FED, Lead Cost Engineer Kennedy Space Center, FL 32899-0001, USA

INTRODUCTION

This new, unique Cost Engineering Report introduces the 800-page, C-100 government estimate for the Space Station Processing Facility (SSPF) and Volume IV Aerospace Construction Price Book. At the January 23, 1991, bid opening for the SSPF, the government cost estimate of \$56,861,983 was right on target. Metric, Inc., Prime Contractor, low bid of \$56,215,000 was 1.2% below the government estimate. This project contains many different and complex systems. Volume IV is a summary of the cost associated with construction, activation and Ground Support Equipment (GSE) design, estimating, fabrication, installation, testing, termination, and verification of this over \$380,000,000 (including GSE and activation) project. Included are 13 reasons the government estimate was so accurate; abstract of bids, for 8 bidders and government estimate with additive alternates, special labor and materials, budget comparison and system summaries; and comments on the \$350,000 energy credit from local electrical utility. This report adds another project to our continuing study of "How Does the Low Bidder Get Low and Make Money?" which was started in 1967, and first published in the 1973 AACE Transaction with 10 more ways the low bidder got low. The accuracy of this estimate proves the benefits of our Kennedy Space Center (KSC) teamwork efforts and KSC Cost Engineer Tools which are contributing toward our goals of the Space Station.

BACKGROUND - SSPF ESTIMATING HISTORY

Some background on the history of budget and preliminary cost estimating is shown in the following chart of comparison of budgeted and estimating cost of the Space Station Processing Facility (SSPF). The budget was developed by John F. Kenndy Space Center from 1983 to 1985 at \$63,200,000 for a 298,000 square foot facility. The Preliminary Engineering Report of June 30, 1986, further defined the requirements. However the scope changed several times adding a cafeteria, air lock, and office mezzanine as shown in Figure I with the 30%, 60%, 90% and 95% design estimates.

FIGURE I - BUDGET COMPARISON PART I

PAGE 2

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Y 32,888,507 39,614,613 Y 37,015,136 42,506,045 FE. FE. FE. FE. FE. A <td< td=""><td>JITE WORN</td><td>2000</td><td></td><td>2.766.672</td><td>1.132.497</td><td></td><td>3.082.216</td><td>3,198,841</td><td>3,103,329</td><td></td><td></td></td<>	JITE WORN	2000		2.766.672	1.132.497		3.082.216	3,198,841	3,103,329		
E 37/015,136 42,506,045 E - - - E - - - - E - 2,000,000 - - - 800,000 - 2,500,000 - - - 900,000 - 2,500,000 - - - 900,000 - 2,500,000 - - - 900,000 - 1,000,000 - - - 9262,805 39,262,805 37,015,136 45,527,966 - 10,986,800 10,986,800 10,214,384 8,075,768 - 93,000,000 3,000,000 3,000,000 3,000,000 - - 93,000,000 1,500,000 3,000,000 - - - 93,000,000 1,000,000 1,000,000 - - - 93,000,000 52,231,405 64,537,405 51,429,52 53,93,714 93,000,000 52,231,405 <td< td=""><td>STRINCTURE TO S'LINE</td><td></td><td></td><td>32,688,507</td><td>39,614,613</td><td></td><td>48,132,821</td><td>49,238,683</td><td></td><td>45,222,214</td><td></td></td<>	STRINCTURE TO S'LINE			32,688,507	39,614,613		48,132,821	49,238,683		45,222,214	
E. E. 2,000,000 B. 2,000,000 B. 2,000,000 3,421,941 B. 2,500,000 3,421,941 B. 2,500,000 3,421,941 B. B. B. </td <td>SHRTDTAI</td> <td>•</td> <td></td> <td>37.015.136</td> <td>42,506,045</td> <td>43,549,501</td> <td>55,441,135</td> <td>57,161,160</td> <td>49,125,591</td> <td>52,067,367</td> <td></td>	SHRTDTAI	•		37.015.136	42,506,045	43,549,501	55,441,135	57,161,160	49,125,591	52,067,367	
E. ·	VISITOR VIEWING GALLERY	•						1,406,418	953,784	1,184,662	
NRJ. VVG & CAFE. ·	CAFETERIA					,		1,583,953	1,048,035	1,043,801	
2,000,000 2,000,000 3,421,941 2,500,000 2,500,000 3,421,941 7,000,000 7,000,000 3,421,941 38,262,805 39,015,136 45,927,986 10,966,600 10,214,384 8,075,788 3,000,000 3,000,000 3,000,000 3,000,000 3,000,000 3,000,000 1,000,000 1,000,000 3,000,000 1,500,000 1,000,000 1,000,000 52,231,405 64,531,405 51,429,520 57,203,774 10 150,000 1,000,000 1,000,000 - 11 50,000 1,000,000 - - 1150,000 1,500,000 1,000,000 - - 1150,000 1,500,000 - - - - 1150,000 52,231,405 69,203,774 - - - 1150,000 51,429,52 5,820,377 - - - - 1150,000 83,830,501 6,2229,719 70,426,566 -	SUBTOTAL INCL. WG & CAFE.			•		•	•	60,151,531	51,127,410	54,295,830	
MIALT 2 P. FEEDER 800,000 · · ND CHILLER 2,500,000 · · · ND CHILLER 2,500,000 · · · · ND CHILLER 2,500,000 · · · · · ND FAPM 7,000,000 · · · · · · ND FAPM 7,000,000 · · · · · · · RICL ESCAL 2,500,000 · <td>TASK VI AMEND I 2500 TON CHILLER</td> <td></td> <td>2,000,000</td> <td>•</td> <td></td> <td>•</td> <td></td> <td>•</td> <td>500,000</td> <td>1,224,231</td> <td></td>	TASK VI AMEND I 2500 TON CHILLER		2,000,000	•		•		•	500,000	1,224,231	
ND CHILLER 2,500,000 · · ND RAPM 7,000,000 · 3,421,941 SEEC.COND. 10,966,500 10,214,394 6,977,966 S. SPEC. COND. 10,966,500 10,214,394 6,075,766 S. SPEC. COND. 10,966,500 10,000,000 1,000,000 S. SPEC. CONTROL 52,231,405 64,511,405 50,429,520 52,03,774 MCL ESCAL & S.C. 52,231,405 64,511,405 51,429,520 58,203,774 U ENDRING 11,600,000 - - - - M EENISE WIRING 11,600,000 - - - - M SECURITY SYST 11,600,000 - - - - M SECURITY SYST 5,744,655 5,623,714 - - M SECURITY SYST 5,740,6455 <t< td=""><td>TASK VII/ALT 2 P. FEEDER</td><td></td><td>800,000</td><td>•</td><td>•</td><td>•</td><td></td><td></td><td>800,000</td><td>612,199</td><td></td></t<>	TASK VII/ALT 2 P. FEEDER		800,000	•	•	•			800,000	612,199	
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32.62.805 32.62.805 37.015,136 45.927.986	PHASE I (ESTIMATE)				3,421,941	3,421,941	•		•	•	
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OTAL 52,231,405 69,281,405 51,429,520 58,203,774 INGENCY 5,223,141 6,928,141 5,142,952 5,820,377 SFFERENCE 5,745,455 7,820,955 5,657,247 6,402,415 SFFERENCE 8,3200,001 83,630,501 6,402,415 70,426,566 SFFERENCE 8,3200,001 83,630,501 6,2229,719 70,426,566 SF: (1) 52,231,405 5,000 TALS 5,142,953 70,426,566 70,426,566 SF: (1) 52,231,405 5,000 SF PER & 30% (\$172,58 SF COST) 6,2229,719 70,426,566 RIGINAL BLDG CONTRACT COST LIMIT (2/9/88) 500,017 55% JODED 3RD FLR & LARGER CAFETERIA. SOUT 75% ADDED 3RD FLR & LARGER CAFETERIA. 200,017 75% ADDED 3RD FLR & LARGER CAFETERIA. 70,426,566 GUT 75% ADDED 3RD FLR & LARGER CAFETERIA. 70,127 70,523,515 70,523,515 70,526,515 GOUT 75% ADDED 3RD FLR & LARGER CAFETERIA. 718,1NCREASE, NEW QUOTES, STEEL, ETC. 20,175% 515,125,055 HOLE NEW EST, RECESSION & MARKET EVAL. PT& INCREASE, NEW QUOTES, STEEL, ETC. 20,1809,919,090 5120,000 512,000 <t< td=""><td>TASK V ENVIRO. MONITORING</td><td></td><td>100,000</td><td></td><td></td><td>•</td><td>•</td><td>•</td><td>100,000</td><td>55,237</td><td>M.D. A&E</td></t<>	TASK V ENVIRO. MONITORING		100,000			•	•	•	100,000	55,237	M.D. A&E
IINGENCY 5,223,141 6,928,141 5,142,952 5,820,377 S,745,455 7,620,955 5,657,247 6,402,415 DFFERENCE 6,3200,001 83,830,501 6,229,719 70,426,566 S5: (1) 52,231,405 6,32,000 83,830,501 62,229,719 70,426,566 S5: (1) 52,231,405 6,32,000 83,830,501 62,229,719 70,426,566 S5: (1) 52,231,405 Marked for take 83,830,501 82,830,501 62,229,719 70,426,566 S5: (1) 52,231,405 Marked for take 30% (\$172,58 SF COST) 62,223,719 70,426,566 RIGINAL BLDG CONTAINED 298,000 SF PER & 30% (\$172,58 SF COST) 50,605 56,57,247 6,402,415 COPE CHANGE To 440,000 SF (\$1,60,58 SF COST) 50,705 51,51 SF COST) 50,705 GOUT 75% ADDED 3RD FLR & LARGER CAFETERIA, COPE CHANGE TO 440,000 SF (\$1,60,58 SF COST) 50,705 51,51 SF COST) HOLE NEW EST, RECESSION & MARKET EVAL. PT& INCREASE, NEW QUOTES, STEEL, ETC. 40,700 SF (\$1,60,58 SF COST) 50,705 HOLE NEW EST, RECESSION & MARKET EVAL. PT& INCREASE, NEW QUOTES, STEEL, ETC. 40,7000 SF (\$1,50,580 SF COST) 51,50,500 SF S	SUBTOTAL	52,231,405	69,281,405	51,429,520			2	76,367,670	-	-	
5,745,455 7,820,955 5,657,247 6,402,415 DIFFERENCE BUDGETED/ESTIMATED TOTALS 6,32,00,001 83,830,501 62,229,719 70,426,566 DIFFERENCE BUDGETED/ESTIMATED TOTALS 6,32,00,001 83,830,501 62,229,719 70,426,566 ES: (1) 52,231,405 JACOBS CONTRACT COST LIMIT (2/9/88) FIGINAL BLDG CONTAINED 298,000 SF PER & 30% (\$172,58 SF COST) 70,426,566 SOPE CHANGED AT 60%, INCREASED SIZE TO 312,396 SF (\$1.91 SF COST) 200T 75% ADDED 3RD FLR & LARGER CAFETERIA, 70,426,566 SOUT 75% ADDED 3RD FLR & LARGER CAFETERIA, 200T 75% ADDED 3RD FLR & LARGER CAFETERIA, 70,426,566 BOUT 75% ADDED 3RD FLR & LARGER CAFETERIA, 200F CHANGE TO 440,000 SF (\$160,58 SF COST) 70,426,566 AOLE NEW EST, RECESSION & MARKET EVAL, PTAI INCREASE, NEW QUOTES, STEEL, ETC. 40,600 SF (\$160,58 SF COST) 10,000 SF (\$1,01 NG HOLE NEW EST, RECESSION & MARKET EVAL, PTAI INCREASE, NEW QUOTES, STEEL, ETC. 40,000 SF (\$1,000 SF (\$1,000 SF (\$1,000 SF (\$1,000 SF (\$1,000 SF (\$1,000 SF (\$0,000 SF (\$1,000 SF (\$1,0	CONTINGENCY	5,223,141	6,928,141	5,142,952	5,820,377						
Bit Reference 63,200,001 83,830,501 62,229,719 70,426,566 Series Internet 63,200,001 83,830,501 62,229,719 70,426,566 Series Internet Series Internet 83,830,501 62,229,719 70,426,566 Series Internet Series Internet 83,830,501 62,229,719 70,426,566 Series Internet Series Internet 83,830,501 83,830,501 83,830,501 83,830,501 Riginal BLDG CONTAINED 296,000 SF PER & 30% (\$172,56 SF COST) DOPE CHANGED 3RD FLR & LARGER CAFETERIA, 00,077,55%, ADDED 3RD FLR & LARGER CAFETERIA, 00,077,55%, ADDED 3RD FLR & LARGER CAFETERIA, SOUT 75% ADDED 3RD FLR & LARGER CAFETERIA, 00,075%, NEW QUOTES, STEEL, ETC. 00,0766 AHOLE NEW EST, RECESSION & MARKET EVAL. PTÅI INCREASE, NEW QUOTES, STEEL, ETC. 00,0766 00,0766 HOLE NEW EST, RECESSION & MARKET EVAL. PTÅI INCREASE, NEW QUOTES, STEEL, ETC. 00,0766 00,0766 BI ISSUED 6/1/90 STO, JACOBS CONTRACT LIMIT 0,0700 0,000 RIGINAL CALLED FOR 2-1500 TON CARRIER CHANGED TO 1-2500 TON 0,0400 0,0400	S&A	5,745,455	7,620,955	5,657	6,402,415			8,400,444		8,417,664	
(\$1.91 SF COST) (\$1.91 SF COST) (\$1.91 SF COST) (\$1.91 SF COST) (\$1.91 SF COST) (\$1.91 SF COST)	CCE	63,200,001	83,830,501	62,229,719				92,404,881	1 88,832,803	92,594,299	
LSF COST) (\$1.91 SF COST) EASE, NEW QUOTES, STEEL, ETC. 1-2500 TON	PCT. DIFFERENCE BUDGETED/ESTIM	ATED TOTALS									
IES, STEEL, ETC.	NOTES: (1) 52,231,405 JACOBS C	CONTRACT COST L	IMIT (2/9/88)			(11) SCOPE CHAN	VGED AGAIN AT 90	% INCREASED 1	0 457,415 SF (154.)	27 SF COST)	
TES, STEEL, ETC.	(2) ORIGINAL BLDG CONTAINED	298,000 SF PER & 3	30% (\$172.58 SF C	(LSO		(12) 100% GOVT.	EST. IS BASED ON	457,415 SF (\$12	4.31 SF COST)		
LI INCREASE, NEW QUOTES, STEEL, ETC. 3 360 TO 1-2500 TON	(3) SCOPE CHANGED AT 60%, IN	CREASED SIZE TO	1312,396 SF (\$1.91	SF COST)		(13) CRANE NOT	IN CONSTRUCTIO	N IFB			
LI INCREASE, NEW QUOTES, STEEL, ETC. 3 5ED TO 1-2500 TON	(4) ABOUT 75% ADDED 3RD FLR	& LARGER CAFETI	ERIA,			(14) BASED ON G	OOD OPEN SHOP	WITH 10 OR MOI	JE BIDS		
T EVAL. PT&I INCREASE, NEW QUOTES, STEEL, ETC. ER FUNDING ACT LIMIT ACT LIMIT RER CHANGED TO 1-2500 TON	SCOPE CHANGE TO 440,000 S	F (\$160.58 SF COS	<u>(1</u>			(15) BASED ON 2	BIDDERS CLOSEL	SHOP \$50 BAR	JEL FOR OIL (KUW	AIT INVASION)	
ER FUNDING ACT LIMIT VIER CHANGED TO 1-2500 TON	(5) WHOLE NEW EST, RECESSIO	IN & MARKET EVAL	. PT&I INCREASE	NEW QUOTES, S	TEEL, ETC.	(16) PHASE I ADD	ED TO SITE & UTI	UTIES, NOT SEP.	ARATE CONTRACT		
ACT LIMIT NER CHANGED TO 1-2500 TON	(6) R&D, R&PM ITEMS FROM C O	F F TO OTHER FUN	VDING			(17) SPEC. COND	NOT NECESSAR	Y DUE TO BID CC	NDITION OVER 61	BIDDERS	
ACT LIMIT (19) (19) (19) (19) (19) (19) (19) (19)	(7) IFB ISSUED 8/1/90					(18) REDUCE PR(JFIT BY 4% & 4% \	VOLUME DISCOU	NT - LARGE PROJE	ECT	
NER CHANGED TO 1-2500 TON (20)	(8) 82,120,889 - 9/18/90 REV. JACI	OBS CONTRACT LI	MIT				IN TOTAL FIGURE:	S			
	(9) ORIGINAL CALLED FOR 2-150	0 TON CARRIER CI	HANGED TO 1-250	NO TON			BS BUDGET EST.	DESIGN CONTR/	ACT COST LIMIT		
I (10) ADDED A 2ND 2500 TON YORK CHILLER	(10) ADDED A 2ND 2500 TON YO	RK CHILLER				(21) 65,889,366	THREE A&E'S C-10	0 ESTIMATE			

STUDY OF GOVERNMENT ESTIMATING AND BIDDING

In mid 1990 as the Space Station Processing Facility (SSPF) design was nearing completion a decision was made to make a special study for improving the accuracy of Government Estimates (Figure 4). The five areas studied were: 1. based on Dr. Martin Skidmore's 1988 reports and center on the bidding and number of bidders, 2. special studies and analysis of previous and current Government Estimates, 3. special studies of low bidder cost estimating, 4. independent analysis of what would the bids be, and 5. specifying what the low bid would be, what the medium bid would be, and what would the high bid be (shown in Figure II). Another area of study is the special review and analysis of the Government Estimates that become the Official Government Estimate.

Dr. R. M. Skitmore, analysis of estimating accuracy based on number of bidders, by contract sum or dollar amount, and by contract period or length of schedule led to an independent study of potential bidders for the SSPF; five lists of potential bidders were used:

1. Source list of 31 pages - 685 sets of half size plans and specifications were sent out to potential bidders - about 30 appeared to be prime contractor bidders

2. Pre-Bid Conference, September 13, 1990 - 14 page list with 7 prime bidders and subs, vendors, etc.

3. Print Shops full size drawing and specification sets - requests at \$580.00 a set list has 12 prime bidders

- 4. Questions from 6 prime bidders, subs and vendors
- 5. Dodge reports list 10 prime's receiving sub bids

SUBSEQUENTLY A LIST OF PROSPECTIVE PRIME BIDDERS FOR THE SPACE STATION PROCESSING FACILITY WAS DEVELOPED

The following list is based on a summation of the previous 5 list of potential bidders: 1. Morrison Knudson (3L-6S), 2. Blout (3L, 4S), 3. W&J (3L), 4. Walsh (4L, 2PS), 5. Auchter (3L), 6. F. J. Rooney (4L, 2S), 7. Taylor Woodrow (3L, 2S), 8. Kiewit NEB (3L), 9. Flour Daniel (1L), 10. Sauer (4L), 11. George Hyman, Tampa (4L 4 Sets), 12. University Mechanical National (1L, 3S), 13. Metric Construction, Tampa (2L), 14. Caddell Construction, AL (3L).

Note: The first number in parenthesis is the number from the 1 through 5 list above, the second number in parenthesis is the number of sets of full size drawings and specifications ordered by the bidder.

THE SUMMARY OF A SPECIAL STUDY AND ANALYSIS OF LOW BIDDERS ESTIMATES FROM KSC COST INDEXES

- 1. Errors in judgement
- 2. Mistakes in estimating and bidding
- 3. Low mark-ups (crew rates, overhead, profit)
- 4. No sales tax, lower or high PT&I rates
- 5. Heavy competition by vendors and subcontractors

PAGE 4

6. High-balling and low-balling by vendors, subcontractors and contractors

7. Computer Estimating and bidding:

a. Using such programs as Timberline to bid and get more jobs

b. Using such scheduling programs as Primavera to get schedule cost estimating

5

c. Bringing in company computer experts to ensure bidding accuracy and speed in getting final bid

d. Using a computer estimating program to get trend ratios of reduction of cuts, subs and quotes with projection to bid time, so bid estimates could be prepared hours early

8. Summarized the project cost estimate using the 16 specification division, such as 1 overhead, 2 site work, 3 concrete, 5 steel, 15 mechanical, 16 electric

9. Assuming in-house sub work to get better sub bids

10. Letting sub take value engineer (VE) risks and giving them the potential savings

11. Special sub bid analysis

12. Companies with outside experience and work, such as process, industrial, etc. getting extra good quotes and volume discounts for the KSC work

13. Bidding extra low to get other future KSC work

14. New construction methods and applications to help cut costs to get more jobs and make money

15. Intentional mistakes on sub bids to let the low bidder off the hook or to allow the general contractor to get the best sub-bids and quotes the day after the bids

16. Bid shopping, bid peddling, bid cutting, cut throat practices, resulting in anger, bitterness, ill will, and cheap substitutions

17. Assuming extra claims and higher change order costs will make the profit

CONTINUING SPECIAL ANALYSIS OF GOVERNMENT ESTIMATES 1989-1991 TO IMPROVE ACCURACY

1. Poor quotes - too high, not enough; should be three quotes on all major cost items to prevent sole source items, to get best discounts and ensure specified items are available

2. Poor breakdowns on major cost items

3. High labor hours - especially mechanical and electrical

4. High mark-ups for taxes, insurance, overhead, and profit

5. Errors in math - quantities, extensions, etc.

6. Sole source items - every effort should be made to have "or equal" items listed on drawings and alternates designs

7. High electrical cost estimates on 4 of 5 recent bids

8. Paving projects - quantities should be figured in square yards and tons due to extra claims on leveling course of pavement

9. Payroll taxes and insurance (PT&I) - Some to high and some to low

Special analysis of estimating independent study - what would the low bid estimate be, medium bid be and high bid be, October 22, 1990, See Figure II. The low estimate of \$51,980,000 based on 10 or more bids - good open shop bidder, the medium estimate of \$55,116,650, the high estimate of \$63,855,000, only 2 bidders, closed shop. Note the C100 A&E estimate of November 12, 1990, was \$65,889,576.

	FIGURE I		COMPARISON OF	PARISON OF BUDGETED AND ESTIMATED COSTS	STIMATED COSTS			PAGE BUDGET-2	
Drawing No. 79K32598 -814 SHTS, 79K33032 -20 SHTS, 79K33144 -4 SHT 82K00912 -76 SHTS, 82K00913 -12 SHTS, 82K00914 -11 SHTS, TOTAL 933 SHTS	79K32598 -814 SHTS, 79K33032 -20 SHTS, 79K33144 -4 SHT , 82K00913 -12 SHTS, 82K00914 -11 SHTS, TOTAL 933 SHTS	0 SHTS, 79K33144 -4 1 SHTS, TOTAL 933 S	s	PCN 93268	LOCATION INDUSTRIAL AF NASA CAUSEWAY, EAST OF O&C	INDUSTRIAL AREA. EAST OF O&C	PROJECT MAIN BUILDING SPACE STATION PROCESSING FAC.	MAIN BUILDING ROCESSING FAC.	
W.O/CONTRACT ARCH./ENG.	NASA PEREZ, DF-FED-32 867-2477	ED-32 867-2477		B	VARNDELL, EG&G CHECKER	CHECKER	JONES, EG&G	CODE C-100	
	JACOBS ENG, RALPH HAHN ASSOC, MACDONNELL DOUGLAS GRUMBA	OC, MACDONNELI	L DOUGLAS	GRUMBACH, JACOBS		DURBIN, JACOBS		SUBMITTED 8/2/91	
		ANALYSIS 10/22/	'90 ESTIMATED BIC) RANGE	10/01/89				
BUDGETED LINE ITEMS	BUDGETED COSTS	row	MEDIUM	HIGH	REV. 10/90 C-100 A&E	01/23/91 C-100			
SITE WORK		2,700,000	3,000,000	3,500,000	3,741,814	3,442,469			
UTILITIES OUTSIDE 5' LINE		250,000	2,500,000	3,500,000	3,103,339	2,855,090			
STRUCTURE TO 5' LINE		39,640,000	39,750,000	44,800,000	42,280,448	38,285,964			
SUBTOTAL		42,590,000	45,250,000	51,800,000	49,125,601	44,583,523			
VISITOR VIEWING GALLERY		1,000,000	950,000	1,200,000	953,984	877,481			
CAFETERIA		1,040,000	1,050,000	1,400,000	1,048,035	964,192			
SUBTOTAL INCL. VVG & CAFE.	61,820,889	44,630,000	47,250,000	54,400,000	51,127,620	46,425,196			
TASK VI AMEND I 2500 TON CHILLER	2,000,000	980,000	980,000	980,000	1,224,231	1,126,963			
TASK VII/ALT 2 P. FEEDER		620,000	620,000	650,000	617,199	611,719			
ALT I 2ND CHILLER	2,500,000	1,250,000	000'006	1,500,000	1,714,958	1,735,898			
R&D AND R&PM	5,000,000	2,500,000	2,500,000	2,500,000	4,424,338	4,681,822			
PHASE I (ESTIMATE)		•	•	-	•	•			
ECBC	72,120,889	49,980,000	52,250,000	60,030,000	59,108,346	54,586,998			
ESCAL & SPEC. COND.	7,000,000	•	550,000	1,300,000	4,506,245	1			
CRANES	3,000,000	(2,500,000)	(2,500,000)	(2,500,000)	(3,092,080)	(3,092,080)			
ECBC INCL ESCAL & S.C.	82,120,889	49,980,000	52,800,000	61,330,000	63,614,591	54,586,998			
GFE	(1,000,000)	-	•	ı	(000'000'1)	(1,010,948)			
TASK II HVAC CONTROL	400,000	350,000	395,492	500,000	353,824	353,824			
TASK III PREMISE WIRING	2,000,000	1,500,000	1.766,968	1,800,000	1,766,968	[']			
TASK IV SECURITY SYST.	150,000	100,000	98,956	125,000	98,956				
TASK V ENVIRO. MONITORING	1000,000	20,000	55,237	100,001	55,237	55,237			
SUBTOTAL	84,770,889	51,980,000	55,116,653	63,855,000	65,889,576	56,861,983			
CONTINGENCY	5,933,962	5,198,000	5,511,665	6,385,500	6,588,958	5,686,198			
S&A	6,349,340	5,717,800	6,062,832	7,024,050	7.247,853	6,254,818			
CCE	97,054,191	62,895,800	66,691,150	77,264,550	79.726.387	68,802,999			
PCT. DIFFERENCE BUDGETED/ESTIMATED TOTALS	IMATED TOTALS								
NOTES: (1) 52,231,405 JACOBS CONTRACT COST LIMIT (2/9/88)	TRACT COST LIMIT (2/9	(88)			(11) SCOPE CHANGE	(11) SCOPE CHANGED AGAIN AT 90% INCREASED TO 457,415 SF (154.27 SF COST)	ASED TO 457,415 SF (154.27 SF COST)	
2) ORIGINAL BLDG CONTAINED 298,000 SF PER & 30% (\$172.58 SF COST)	000 SF PER & 30% (\$17)	2.58 SF COST)			(12) 100% GOVT. EST	(12) 100% GOVT. EST. IS BASED ON 457,415 SF (\$124.31 SF COST	SF (\$124.31 SF (0051)		-1
(3) SCOPE CHANGED AT 60%, INCREASED SIZE TO 312,396 SF (\$1.91 SF COST)	EASED SIZE TO 312,396	SF (\$1.91 SF COST)			(13) CRANE NOT IN CONSTRUCTION IFB	ONSTRUCTION IFB			
(4) ABOUT 75% ADDED 3RD FLR & LARGER CAFETERIA,	ARGER CAFETERIA,				(14) BASED ON GOOL	(14) BASED ON GOOD OPEN SHOP WITH 10 OH MORE BIUS	oh mohe bius ea rading foo oil a	A MAINT IN ACION	_
SCOPE CHANGE TO 440,000 SF (\$160.58 SF COST)	160.58 SF COST)					(15) BASED ON 2 BIDDEHS CLOSED SHOP \$30 BARREL FUR OIL (NUWALI INVASION)		INDIGAVII I MAD	
(5) WHOLE NEW EST, RECESSION & MARKET EVAL. PT& INCREASE, NEW QUOTES, SI	MARKET EVAL. PT&I IN	ICREASE, NEW QUOTE	ES, STEEL, ETC.		(16) PHASE I ADDED	(16) PHASE I ADDED TO SITE & UTILITIES, NOT SEPARATE CONTRACT	OT SEPARATE CONTR	ACT	
(6) R&D, R&PM ITEMS FROM C OF F TO OTHER FUNDING	TO OTHER FUNDING				(1/) SPEC. COND. NC	(1/) SPEC. COND. NOT NECESSARY DUE TO BID CONDITION OVER 9 BIDDERS		H & BIUUEHS	_
(7) IFB ISSUED 8/1/90					(18) REDUCE PROFI	(18) REDUCE PROFIL BY 4% & 4% VOLUME UISCOUNT - LANGE PROJECT	UISCOUNI - LAHGE PI	JUELI	
(6) 62,120,669 - 9/18/90 REV. JACOBS CONTRACT LIMIT	CONTRACT LIMIT	TO 1 0100 TONI) NUT IN TOTAL FIGURES		F	
(9) ORIGINAL CALLED FOR 2-1500 TON CARRIER CHANGED 10 1-2500 10N	ON CARRIER CHANGED	10 1-2500 LUN			(ZU) JACUBS 1	BUUGELEST. UESIGIN			
(10) ADDED A 2ND 2500 TON YORK CHILLER	HILLER				(21) 65,889,300 Inn	(21) 65,889,366 IHHEE A&E'S C-100 ESTIMATE			-

ANALYSIS SUMMARY OF DETAIL STUDY ON GOVERNMENT ESTIMATING, NUMBER OF BIDDERS STUDY, AND LOW BIDDERS ESTIMATING AND CONSTRUCTION ECONOMY-MARKET

1. Over 7 bidders, therefore the price would be 7% to 22% lower than the average government estimate, per number of bidders charts, or extra the competition reduces the bid price 7% to 22% (see Chart Page 9 - Number of Bidders).

2. Plenty of open shop bidders therefore 30% premium for union type bidders is not necessary (not union price) (see Aerospace Construction Cost Estimating).

3. Very good competition, hungry market, middle east Kuwait/Desert Storm conflict should not effect price or add escalation. Barrel/price of oil should stay \$20.00 to \$25.00 a barrel.

4. Increase Emphasis on more and better budget quotes breakdown on major cost items in the Government Estimate.

5. Bidding mark-ups can be reduced - Overhead from 15% to 10%, profit and prime mark-up reduced volume, discount should be included 2% - 10%. (VAB government estimate used 3% profit) (see Figure III and Launch Pad to Moon - Bidding Cost of VAB) - See OPF System Summary used 3% overhead and 5% profit, see Aerospace Price Book Volume III, Sheet 2, Bid May 14, 1975. SEE PAGE 28

6. Special condition of 3% - 10% not needed. Normally used during boom time construction when few bidders. (See Figure III) Labor and material summary shows no special conditions were used. Also see Government Bid Estimates Compared to General Contractor Bid Estimates, AACE 33rd Meeting, and Contractor Analysis Chart by Perez and Brown.

SEE PAGE 27 - COMPUTER ANOLYSIS LDE/LCE

SPEA			8/2/91	PROJECT	TOTALS	2,168,682	20,052,187		5,966,908	856.221	679,524	485,318	473,223	3,121,503	330,986		612,511		1,393,831	202,192		_			521,101		~		3,616,915		4		2 51,295,893	3 3,590,712	54,886,605		3	5 562,989	5 56,861,983	
PAGE LMSSPFA		SPACE STATION PROCESSING FACILITY	CODE SUBMITTED	OTHER	MATERIAL	II																	1,069,344	188,819		_	1,258,163	75,490			1,521,656	152,166	1,673,822	117,168	1,790,990	89,550	1,880,540	18,805	1,899,345	
		ION PROCE		ЦO	LABOR	TASK VI - VI																	73,756	70,862	-	144,618			43,385	188,003										
		SPACE STAT	JONES, EGRIG VCOBS	SPECIALIZED CONSTR	MATERIAL	0							331,356					-				3,010,907			307,107		3,649,370	218,962		3,868,332	4,330,951	433,095	4,764,046	333,483	5,097,529	254,876	5,352,405	53,524	5,405,929	
	1		CHECKER JONES DURBIN, JACOBS	SPECIALIZ	LABOR	R&D							141,867												213,994	355,861			106,758	462,619										
DINGS		i l	<u>،</u> ۳	ICAL	MATERIAL									1,945,565	210,015				1,246,741	101,165							3,503,486	210,209	(25%)	3,713,695	5,644,978	564,498	6,209,476	434,663	6,644,139	332,207	6,976,346	69,763	7,046,109	
X FOR BUILI	VECTIVITIETRIAL ADEA	NASA CAUSEWAY, EAST OF O&C	ESTIMATOR VAIRNDELL, EGRIG GRUMBACH, JACOBS	СTH	LABOR									1,175,938	120,971				147,090	101,027						1,545,026			386,257	1,931,283										
ST SUMMAR			RUMBACH	CAL	MATERIAL				3,549,229	355,985	357,067	386,722					51,535										4,700.538	282,032		4,982,570	9,365,628	936,563	10,302,191	721,153	11,023,344	551,167	1,574,511	115,745	11,690,256	
MATERIAL COST SUMMARY FOR BUILDINGS		SZ		MECHANI					2,417,679 3	500,236	322.457	98,596					32,615									3,371,583			1,011,475	4,383,058			-		-		-			
LABOR AND N	100	с и 93268	ACDONNE	RUCT.	MATERIAL		14,312,610																				14,312,610	858,757		5,171,367	22,632,817	2,263,282	24,896,099	1,742,727	26,638,826	N/A	26,638,826	266,388	26,905,214	
		1	NASA PEREZ, DF-FED-32 867-2477 G, RALPH HAHN ASSOC, MACDC	ARCHIT./ST			5,739,577 14						CLUSTER													5,739,577	-		1,721,873	7,461,450 15,171,367	7		2							
		613 + EO'S	ASA PEREZ, I RALPH HAF		MATERIAL	1,163,152				-			S/ POWER C				376,668						ER				1,539,820	92,389		1,632,209	3,136,599	313,660	3,450,259	241,518	3,691,777	184,589	3,876,366	38,764	3,915,130	
FIGURE	10	_	ARCH./ENG. N/ JACOBS ENG,	SITEWORK ARCHIT./STRUCT.	LABOR N	1,005,530 1							PAGING/UP				151,693		•				D TON CHILL	ER FEEDER		1,157,223			347,167	1,504,390										
			W.O/CONTRACT AF NASIO-11800 JA				ARCH./STRUCT.	INTERIOR MECHANICAL	A/C	PLUMBING	FIRE PROTECTION	VACUUM SYSTEM	INTERIOR ELECTRICAL R&D PAGING/UPS/ POWER	POWER & LIGHT	INSTR. & COMM.	exterior utilities	MECH. FIRE LINE S&W	ELECTRICAL	POWER & LIGHT	INSTR. & COMM.	SPECIALIZED CONSTR.	STRUC. OFFICE FURN.	MECHANICAL TASK VI, 2500 TON CHILLER	ELECTRICAL TASK VII, POWER FEEDER	NITROGEN/HELIUM VENTS	SUBTOTAL, LABOR	SUBTOTAL, MATERIAL	SALES TAX 6%	PT&I 30%	SUBTOTAL	IOIAL	CONIR. OVERHEAD 10%	SUBTOTAL	CONIR. PROFIL 7%	SUBTOTAL	PRIME MARKUP 5%	SUBIOTAL	BOND 1%	<u>[</u>]	NOTES

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ABSTRACT OF BIDS

BID OPENING: 1-23-91 - SPACE STATION PROCESSING FACILITY

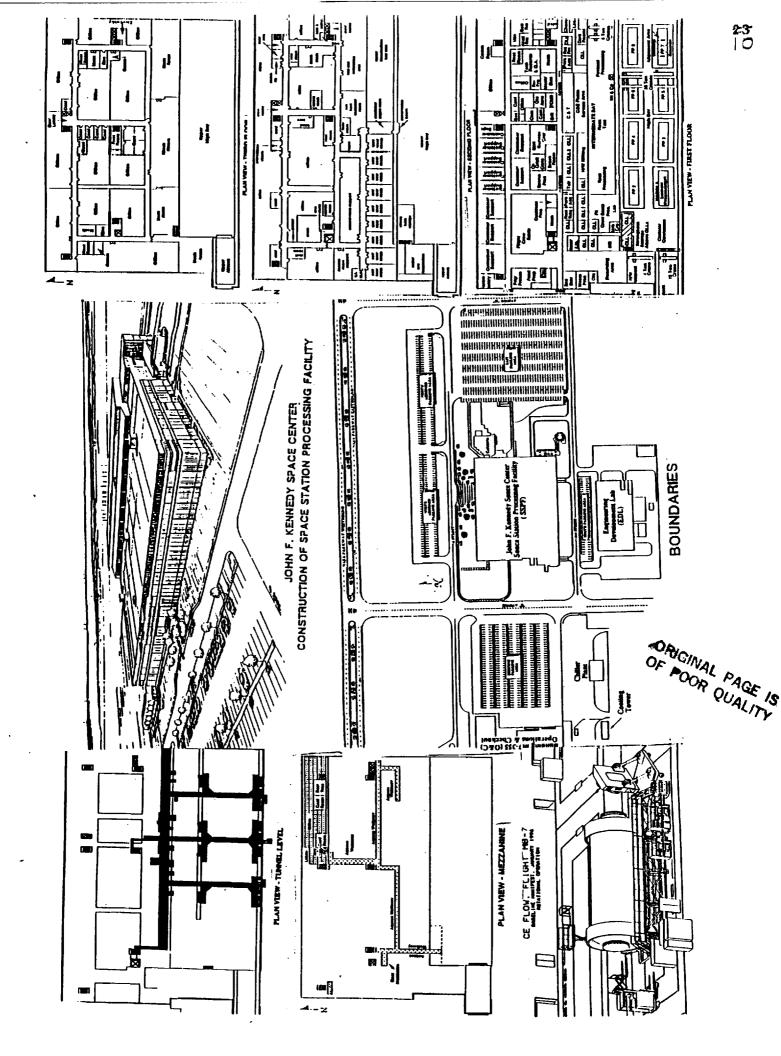
IFB 10-0055-0	PCN 932	68	ADVERTISE I	DATE: 8/1/90	
<u>Contractor</u>	<u>Task I-V</u> Base Bid	<u>Task VI</u> Additive 2500-T Chiller	<u>Task VII</u> Additive Power Feeder	<u>Total Bid</u>	<u>* Gov. CE</u>
1. Metric Const. Tampa, FL	\$54,780,000	\$1,150,000	\$285,000	\$56,215,000	- 1.2%
 Govt. Est., Jacobs/Hahn/MDAC 	\$54,508,886	\$1,735,898	\$617,199	\$56,861,983	0
3. W&J Const. Cocoa, FL	\$55,955,000	\$1,300,000	\$330,000	\$57,585,000	+ 1.3%
 Blount Bros. Montgomery, AL 	\$56,998,000	\$1,400,000	\$400,000	\$58,798,000	+ 3.4%
5. Centex-Rooney Ft. Lauderdale, FL	\$57,627,000	\$1,216,000	\$327,000	\$59,170,000	+ 4.1%
6. Sovran Const.Winter Park, FL	\$58,341,058	\$1,283,228	\$331,290	\$59,955,576	+ 5.4%
7. Caddell/Hardway Montgomery, AL	\$60,498,000	\$1,295,200	\$315,000	\$62,108,000	+ 9.2%
8. Walsh Const. Trumbly, CT	\$60,500,000	\$1,395,000	\$347,600	\$62,242,800	+ 9.5%
9. M. K. Ft. Lauderdale, FL	\$68,967,000	\$1,400,000	\$385,000	\$70,761,000	+24.4%

1

* Percent difference from the government estimate.

This was an excellent government estimate, since NASA's Policy is fair and reasonable cost estimates and for the government estimate <u>not to be low</u>. The SSPF government estimate splits the difference between the low bidder and the second low bidder (see Abstract of Bids). Comparison with the low bidder after awards at the pre-award conference showed the low bidder estimates were very close and government estimate on all major cost items, especially steel, mechanical, concrete, electrical, civil site work, etc., except the additive alternates. This was the best yet on the biggest KSC construction bid since the VAB bid January 7, 1964. A special NASA letter dated January 24, 1992, was sent out congratulating the KSC team: Engineering Development/Procurement Civil Servants, Jacobs Engineering Group, Inc., MacDonnell Douglas, Ralph Hahn and Associates, EG&G Vendors, sub contractors, etc. for their help with the excellent Government estimate. A special thank you to the Lead Design Engineer, Jose Perez-Morales, and Howell H. Row, Chief, Facilities Division and Joseph A. Brown, Lead Cost Engineer.

See plans, elevation and special features chart with the site plan and space module checkout platforms and SSPF System Summary, Pages 7 and 8.



SHEET 1 OF 10

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814 SHIS, /9433002 - 12 SHIS, 2900013 - 12 SHIS, 200013 - 12 SHIS, 82000 AMCHENA, MAEDONIN JACOBS ENG. GROU JACOBS ENG. GROU JACOBS ENG. GROU 20000 UF 10,750 UF 222,552 CY 66,009 CY 10,750 UF 10,750 UF 11,354 TON 1 1,354 TON 2 3653 CY 16,000 UF 23,650 UF 16,000 UF 23,650 UF 16,000 UF 23,650 UF 23,650 UF 16,000 UF 23,650 UF 24,550 UF 25,550 UF 25,5500 UF 25,5500 UF 25,5500 U	20 SHTS. 79X331 PI 4 - 11 SHTS. 79X331 F. NASA JOE PEI 7.UNIT 5/85F 7.JUNIT 5/85F 13.61 8.39 6.40.238 0.18 8.8.97 0.38 8.8.97 0.38 8.8.97 0.38 8.8.97 0.38 8.8.97 0.38 8.8.97 0.38 8.8.97 0.38 8.8.01 1.19 5.05 0.51 1.5.05 0.51 1.5.05 0.51 1.5.05 0.51 1.5.05 1.19 5.80 14 0.55 5.80 14 0.55 5.80 1 0.55 5.80 1 1.30 1.30 1.35 1.35 1.35 1.35 1.35 1.35 1.35 1.35 1.35 1.35 1.35 1.35	IT44 - 4 SHIS IOTAL 933 SHI FREZ DF-FED- 84.720 84.720 7 1.291.919 7 1.291.919 7 1.291.919 7 1.291.919 7 1.291.919 7 1.291.919 7 1.297.35 8 1.060.759 5 554.944 7 1.479.745 5 554.944 7 1.4861.076 8 2.70.603 8 2.70.603		GOVENNEE CH. JACOBS CH. JACOBS TITLE TITLE ARBHOMER ARBHOMER A BRLOG TITLE A BRLOG TITLE A BRLOG TITLE	MI ES INMU EL CON DOULO LOCATION XISC. INDUST. AREA. NASA VARNDELL EGAG 832.1 GIY UNIT S/UNIT 180 EA 1.890.3 27 EA 18.981.7 27 EA 18.981.7 27 EA 18.981.7 4.7.808 EA 18.981.7 4.4.006 SF 14.1	6 8321 6 8321 5/UNIT 1 890.36	NUSEWAY. EAST O CHECKE JONES. E DURBIN, JACOBS S/BSF TOTAL	CAUSEWAY, EAST OF ORC CHECKE JONES, EGRIG 832. DURBIN, JACOBS	BC G 832.1 DIV. TOTAL 340,264	PROLECT SPACE STATION PROCESSING FACUITY SPACE STATION PROCESSING FACUITY CODE SUBMITTED 817/90 S.S. 2 DESCRIPTION SCOPE BASE PLA COMMENTS SCOPE BASE PLA COMMENTS	PROCESSING FACILITY CODE C-100 SUBMITTED &17700 S.S. 2701 DESCRIPTION
DRAWING NG. 79/C23596 - 814 SHTS, 79/C23596 - 814 SHTS, 79/C23591 - 12 SHTS, 82/000914 WORKCAPOENCONTRACT ARCURENCE, MACDONNELL WASTO-11800 JACOBS ENG. GROUP, N. DN. ITTLE STT 287,611 CY 13.1 DN. ITTLE STT 287,611 CY 13.1 DN. ITTLE STT 287,611 CY 13.1 CIEVA & GRUB A1.4 ACR 2.046 DN. ITTLE SATTHWORK RLL 225,552 CY 3.1 CIEVA & GRUB A1.4 ACR 2.046 4.1 DN. ITTLE SACORFIL TUNNEL 222,552 CY 3.1 CIEVA & GRUB 70,218 57 18.2 4.1 DNUNDECAPE & FENCE 1,354 10N 1.072 UTL/FRELWEPPE 1,354 10N 1.072 CONCRETE 22.405 CY 4.4 J. CONCRETE 22.405 CY 14.1 LONNOSCAPE & FENCE 1,354 10N 1.072 CONCRETE 22.405 CY 235<	SHIS. 79K33 SHIS. 79K33 I.I. DOUGE A3 NASA JOE P NASA JOE P 3.1361 3.146 1.11 3.468 1.11 3.469 0.11 3.470 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.16 3.48 1.1.2 3.48 1.1.2 3.47 1.1.2 3.47 1.1.2 3.47 1.1.1 3.47 1.1.1 3.47 1.1.1 3.47 1.1.1 3.47 1.1.1 3.47 1.1.1 3.47 1.1.1 3.48 3.05 3.49	Traa - 4 SH1 - 7 Taa - 4 SH1 - 7 Taa - 4 SH1 - 101AL 933 - 5 - 174 - 1 - 1291 - 9 - 11291 - 9 - 1291 - 9 -		CH, JACOBS TITLE TITLE A ARSHOWER A ARSHOWER A ARSHOWER A ARSHOWER A ARSHOWER A ARSHOWER FOOK EQ. I CONST. A TILE A BLOG. SYS.	CCATTON CSC. INDUST. AR VARINDELL EG& QIY UNIT 180 EA 27 EA 27 EA 27 EA 47.808 SF	64, NASA CA 6 832.1 5 832.1 5/UNIT 1, 890.36	USEWAY DHECKE J DURBIN.	EAST OF O IONES, EG& IACOBS	&C G 832.1 DIV. TOTAL 340.264	PROLECT SPACE STATION PROCES SPACE STATION PROCES SUMME SCOPE BASIC PU SCOPE BASIC PU	SING FACILITY C: 100 0 417190 5.5. 281 101
821000912 - 76 SH15, 828000913 - 12 SH15, 821000914 workcredencommunity family and construction and construc	I.d. I.d. <th< th=""><th>IDIAL 733 F. RALPH HA F. RALPH HA F. RALPH HA F. 101AL 5 774,14 5 774,14 5 774,14 1,291,91 1,291,91 1,200,73 5 539,81 5 539,81 5 7,851,00 5 7,851,00 5 7,851,00 5 7,851,00 5 7,066,00 5 7,006,00 5 7,000,000 5 7,0000 5 7,00000 5 7,00000 5 7,00000 5 7,00000 5 7,00000 5 7,00000</th><th>88 8</th><th>CH, JACOBS TITLE LITES A ARSHOMER A ARSHOMER FINE FOCK EQ L CONST. L CONST. A TILE A SYS. R BLOQ. TYING SYS.</th><th>VARNDELL EGE QIY UNIT 180 EA 180 EA 27 EA 27 EA 27 EA 47,806 SF 4,040 GE</th><th>G 832.1 \$/UNIT 1,890.36</th><th>S/BSF</th><th>IONES, EGA</th><th>G 832.1 DIV. TOTAL 340.264</th><th>CODE SUBMITTE DESCRIP SCOPE BASIC PU Falle</th><th>C-100 0 4/7/90 S.S. 2/91 10/1</th></th<>	IDIAL 733 F. RALPH HA F. RALPH HA F. RALPH HA F. 101AL 5 774,14 5 774,14 5 774,14 1,291,91 1,291,91 1,200,73 5 539,81 5 539,81 5 7,851,00 5 7,851,00 5 7,851,00 5 7,851,00 5 7,066,00 5 7,006,00 5 7,000,000 5 7,0000 5 7,00000 5 7,00000 5 7,00000 5 7,00000 5 7,00000 5 7,00000	88 8	CH, JACOBS TITLE LITES A ARSHOMER A ARSHOMER FINE FOCK EQ L CONST. L CONST. A TILE A SYS. R BLOQ. TYING SYS.	VARNDELL EGE QIY UNIT 180 EA 180 EA 27 EA 27 EA 27 EA 47,806 SF 4,040 GE	G 832.1 \$/UNIT 1,890.36	S/BSF	IONES, EGA	G 832.1 DIV. TOTAL 340.264	CODE SUBMITTE DESCRIP SCOPE BASIC PU Falle	C-100 0 4/7/90 S.S. 2/91 10/1
Machine Machine Machine DN. TILE QIV. TILE QIV UNIT \$/UNIT DN. TILE QIV. TILE QIV UNIT \$/UNIT (2) SITE WORK 287,611 CY UNIT \$/UNIT (2) SITE WORK 287,611 CY 13. (2) SITE WORK 287,611 CY 13. CLEMA & GRUB 8,297 LF 6.045 DAULWICE 2,2552 CY 3. EATITHWORKFILL 222,552 CY 5. EXAMMORKFILL 222,552 CY 5. EVANCERE 10,750 LF 6.0 UNDECAPE & FENCE 1,354 TON 1.072 CONCRETE 22,405 CY 8. 4 LUNDECAPE & FENCE 1,354 TON 1.072 CONCRETE 22,405 CY 10. 1.072 CONCRETE 23.54 TON 1.072 2. CONCRETE 23.643 TON 2.046 <th>ILL DOUGLAS NASA JOE P 1.011 8.03 1.011 8.03</th> <th>EREZ DF-FE EREZ DF-FE B 1774,14 5 774,14 5 774,14 5 1291,91 1 1,291,91 1 1,409,72 5 539,81 5 534,94 5 7,851,00</th> <th></th> <th>CH, JACOBS TITLE LITES A ARSHOMER A ARSHOMER FOOCK EQ. I CONST. I CONST. A TILE A SYS. R BLOQ. YING SYS.</th> <th>QIY UNIT QIY UNIT 180 EA 180 EA 27 EA 27 EA 27 EA 47,806 SF</th> <th>\$/UNIF 1,890.36</th> <th>S/BSF</th> <th>ACOBS</th> <th>DIV. TOTAL 340.264</th> <th>SUBMITTE DESCRIP SCOPE BASIC PU Falle</th> <th>D SY 7/20 S.S. 291</th>	ILL DOUGLAS NASA JOE P 1.011 8.03 1.011 8.03	EREZ DF-FE EREZ DF-FE B 1774,14 5 774,14 5 774,14 5 1291,91 1 1,291,91 1 1,409,72 5 539,81 5 534,94 5 7,851,00		CH, JACOBS TITLE LITES A ARSHOMER A ARSHOMER FOOCK EQ. I CONST. I CONST. A TILE A SYS. R BLOQ. YING SYS.	QIY UNIT QIY UNIT 180 EA 180 EA 27 EA 27 EA 27 EA 47,806 SF	\$/UNIF 1,890.36	S/BSF	ACOBS	DIV. TOTAL 340.264	SUBMITTE DESCRIP SCOPE BASIC PU Falle	D SY 7/20 S.S. 291
MASTURFTIOUL DAY. TILE QIV UNIT S/UNIT ON. TILE QIV UNIT QIV UNIT S/UNIT (2) SIFE WORK 287,611 CY 13. CLEAR & GRUE 3.297 UF 0.04. CLEAR & GRUE 3.275 5.22 5.23 EAMTHMORKFILL 222,552 CY 3. EAMTHMORKFILL 222,552 CY 3. EAMTHMORKFILL 222,552 CY 3. EAMTHMORKFILL 222,550 UF 6. EAMTHMORKFILL 222,500 LF 6. MADORK 1,354 TON 1.072 EAMANGAGEL 228,101 SF 4. J) CONCIRETE 2.36.33 CY 147 GONCRETE 2.36.33 CY 147 GONCRETE 3.66.3 CY 147 GONCRETE 3.66.3 CY 147 GONCRETE 3.66.3 CY 147 GONCRETE <td< th=""><th>INIT \$/851 13.61 8.33 13.61 8.34 13.61 8.33 13.61 8.34 13.61 8.33 3.465 1.11 3.465 1.61 8.372 1.61 8.470 0.31 8.470 0.31 8.470 0.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 <!--</th--><th>IOTAL 101AL 112AL 112AL<!--</th--><th></th><th>ON COSTS DN. ITTLE DN. ITTLE NAT LOOKER ARSHOWER 11) EQUIPMENT TREEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000. FLOOR SYS. ELEV. FLOOR SYS. ELEV. FLOOR SYS. 14) CONVEVING SYS.</th><th>200 25 31 51 80 80 S</th><th></th><th>S/BSF</th><th></th><th>DIV. TOTAL 340.264</th><th>DESCRIP SCOPE BASIC PU</th><th>NO</th></th></th></td<>	INIT \$/851 13.61 8.33 13.61 8.34 13.61 8.33 13.61 8.34 13.61 8.33 3.465 1.11 3.465 1.61 8.372 1.61 8.470 0.31 8.470 0.31 8.470 0.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.31 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.33 8.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 9.470 2.34 </th <th>IOTAL 101AL 112AL 112AL<!--</th--><th></th><th>ON COSTS DN. ITTLE DN. ITTLE NAT LOOKER ARSHOWER 11) EQUIPMENT TREEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000. FLOOR SYS. ELEV. FLOOR SYS. ELEV. FLOOR SYS. 14) CONVEVING SYS.</th><th>200 25 31 51 80 80 S</th><th></th><th>S/BSF</th><th></th><th>DIV. TOTAL 340.264</th><th>DESCRIP SCOPE BASIC PU</th><th>NO</th></th>	IOTAL 101AL 112AL 112AL </th <th></th> <th>ON COSTS DN. ITTLE DN. ITTLE NAT LOOKER ARSHOWER 11) EQUIPMENT TREEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000. FLOOR SYS. ELEV. FLOOR SYS. ELEV. FLOOR SYS. 14) CONVEVING SYS.</th> <th>200 25 31 51 80 80 S</th> <th></th> <th>S/BSF</th> <th></th> <th>DIV. TOTAL 340.264</th> <th>DESCRIP SCOPE BASIC PU</th> <th>NO</th>		ON COSTS DN. ITTLE DN. ITTLE NAT LOOKER ARSHOWER 11) EQUIPMENT TREEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000. FLOOR SYS. ELEV. FLOOR SYS. ELEV. FLOOR SYS. 14) CONVEVING SYS.	200 25 31 51 80 80 S		S/BSF		DIV. TOTAL 340.264	DESCRIP SCOPE BASIC PU	NO
QIV UNIT S 287,611 CY 2 41.4 ACR 2 8.297 LF 3 222.552 CY 6 30.059 CY 10,750 10,750 LF 70,218 70,218 S 7 11,980 EA 11,980 222,405 CY 1 11,354 TON 1 11,354 TON 1 11,354 TON 2 3663 CY 2 23,466 CY 1 11,354 TON 2 3.663 CY 1 11,354 TON 2 3.660 LF 3 3.610 S 3 45,44 TON 2 3.610 S 3 3.610 S 3 3.610 S 3 3.610 S 3			DN. TOTAL 3.915.129 5.265.996 2.37.399 9.792.395	ON. TITLE 10) SPECIALTIES ART LOCKER ARSHOWEN 11) EQUIPMENT REEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000, FLOOR THE ELEV. FLOOR SYS. EMB CHILLER BLOG. 14) CONVEVING SYS.	200 20 3 3 5 80 90 S		S/BSF		DN. 101AL 340,264	SCOPE BASICPU	
287,611 CY 41.4 LF 222,552 CY 8,297 LF 8,297 CY 66,069 CY 10,750 LF 70,218 SY 1,980 EA 1,980 EA 1,980 EA 1,354 TON 1 1,354 TON 2 3,653 CY 2,2500 LF 1,354 TON 2 3,653 CY 1,354 TON 2 3,653 CY 1,354 TON 2 3,650 LF 3,650 CY 1,354 TON 2 3,650 CY 1,354 TON 2 1,557 CY 1,557 CY 1,556			3.915.129 5.265.996 5.265.996 237.399 9.792.395	10) SPECIALITES ART LOCKER ARSHOWER 11) EQUIPMENT REEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2040. FLOOR SYS. ELEV. FLOOR SYS. ELEV. FLOOR SYS. 14) CONVEVING SYS.	┝╼╄╼╄╍╀┉╀╴╀╴╂╸╀┉	1,890.36		TOTAL	340,264		L COMMENIS
41.4 ACR 2 8.297 LF 222.552 CY 65.069 CY 10.7550 LF 70.218 57 70.218 57 70.218 57 70.218 57 70.218 57 70.218 57 70.22405 CY 11.354 TON 12.22405 CY 13.553 CY 25.000 LF 13.553 CY 25.000 LF 13.553 CY 25.000 LF 23.550 LF 10N 22 23.550 LF 23			5.265.996 5.265.996 237.399 9.792.395	ART LOCKER ARSHOWER TEEZERAREF/DOCK EQ. 13) SPECIAL CONST. 2000, FLOOR TILE ELEV. FLOOR SYS. EMB CHILLER BLOQ. 14) CONVEVING SYS.	╺╴┠╍╌┠┈┟╴╴┞╶╴┠╼╌┠┉	1 890.36	Q.73			2 AVERAGE B. RECTA	2. AVENAGE B. RECTAN TEAM EFFORT CAVSERN.
222.5552 CY 8.2377 LF 8.237552 CY 8.6.069 CY 10.7590 EA 1.3960 EA 1.3960 EA 1.3964 TON 1 1.354 TON 2 3.663 CY 1.354 TON 2 3.653 CY 1.354 TON 2 3.653 CY 1.354 TON 2 3.650 LF 1.354 TON 2 3.650 CY 1.354 TON 2 1.557 CY 1.356 CY			5.265.996 5.265.996 237.399 9.792.395	11) EQUIPMENT REEZERREF/DOCK EQ. 13) SPECIAL CONST. 2040: FLOOR TILE ELEV. FLOOR SYS. EMB CHILLER BLOG. 14) CONVEVING SYS.	┠╍┦┉┞┈┞┈╄┈╄┉		0.73	340.264		1 0000 C. MREG.	ALE & SUPPORT CONT
222.552 CY 65.069 CY 65.069 CY 70.218 5Y 70.218 5Y 71,980 EA 71,980 EA 71,980 EA 71,980 EA 71,980 EA 7,018 5F 47,018 5F 45.44 TON 2, 45.44 TON 2, 3.653 TON 1, 1.666 TON 1, 3.653 TON 1, 1.666 TON 1, 3.654 TON 2, 4.544 TON 2, 3.654 TON 2, 4.544 TON 2, 3.654 TON 1, 1.666 TON 1, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 3.654 TON 1, 1.666 TON 1, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 3.654 TON 1, 1.666 TON 1, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 3.654 TON 2, 1.666 TON 1, 3.654 TON 2, 3.654 TON 2, 3.			5.265.996 5.265.996 237.399 9.792.395	REEZERAREF/DOCK EQ. 13) SPECIAL CONST. DND. FLOOR TILE ELEV. FLOOR SYS. EMB CHILLER BLOQ. 14) CONVEVING SYS.	┝┉╀┈╀╌╀┈╀┉	18,981.70	1.10		512,506	A. COMPLEX ILL VEHY 6. SOPHISTICATE IRREGU	ESPECIALLY & PEREZ
222,406 CY 10,750 LF 70,218 5Y 70,218 5Y 70,218 5Y 70,218 5Y 1,354 TON 1, 1,354 TON 2, 3,653 CY 3,653 CY 1,354 TON 2, 4,544 TON 2, 3,654 TON 1, 1,664 TON 1, 3,653 TON 1, 1,664 TON 2, 3,610 SF 3,610 SF 3,610 SF 4,610 CN 1, 1,664 TON 1, 1,66			5.265.996 5.265.996 237.399 9.792.395	13) SPECIAL CONST. DND. FLOOR TILE ELEV. FLOOR SYS. ENBICHLER BLOG. 14) CONVEVING SYS.	┠─┠─┠─╂─	16,961.70	1.10	512,506		VERY GOOD COMP. CLOSE	STOUNG DISCOUNT ON (
10,750 EA 70,218 57 70,218 57 70,218 57 22,406 C7 22,406 C7 1,354 T0N 1, 3,663 C7 1,354 T0N 2, 45,44 T0N 2, 45,44 T0N 2, 3,634 T0N 2, 1,66 T0N 1, 3,610 5F 3,610 5F 4,510 5F 3,610 5F 5,610 5F 5			5.265.996 5.265.996 237.399 9.792.395	COND. FLOOR TILE ELEV. FLOOR SYS. EMB CHILLER BLOG. 14) CONVEVING SYS.	┞╴┠╸┠╸	15.48	1.75		815,395	FOR VOLUME, ALE WAS 65, 205, 000, DF-FED CUT EST	ROGIONAL DEFEDICUTEST
10,218 57 70,218 57 70,218 57 22,406 57 22,406 57 1,354 10N 1, 3,663 57 3,663 57 3,663 57 1,354 10N 2, 4,544 10N 2, 4,544 10N 2, 3,634 10N 2, 1,66 10N 1, 3,61 16 2,60 10N 1, 3,61 16 2,60 10N 1, 2,60 10N 2, 2,60			5.265.996 237.399 9.792.395	ELEV. FLOOR SYS. EELE CHALER BLOG. 14) CONVEVING SYS.	↓ .					4% OFF PROFIT, 4% FOR VOLUME DISCOUNT	LUME DISCOUNT
70218 37 229,101 5F 229,101 5F 1,356 10N 1 1,356 10N 1 3,663 CY 3,663 CY 3,663 CY 1,356 10N 2 45,44 10N 2 3,634 10N 2 3,634 10N 2 3,634 10N 2 3,610 5F 3,610 5F 4,610 5F 3,610 5F 4,61 10 5F 3,610 5F 4,61 10 5F 3,610 5F 4,61 10 5F 3,610 5F 4,61 10 10 10			5.265.996 5.265.996 237.399 9.792.395	EMB CHALLER BLOG	+	1419	5 4.1	678,160			ESIGN DATA VIET EDALAE SIDINIC
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229,101 SF 1,336,100 SF 1,336,100 LF 3,663 CY 3,663 CY 3,664 TON 2, 4,544 TON 2, 4,544 TON 2, 4,544 TON 2, 4,544 TON 2, 3,651 TON 1, 1,066 TON 1, 4,60 TON 1, 4,60 TON 1, 2,00 EA			237.399		┣—	94.319.60	1 <u>0</u>		471,598	STRUC, FRAME & STORA	
257.101 34 1.334 TON 1 1.334 TON 2 3.653 CY 3.653 CY 3.654 TON 2 4.544 TON 2 3.654 TON 2 3.654 TON 3 4.544 TON 3 4.544 TON 3 4.544 TON 3 4.544 TON 3 4.544 TON 2 5 4.544 TON 2 5 4.544 TON 2 5 5 5 5 5 5 5 5 5 5 5 5 5			237.399	EI EVATORS	5	94,319.60	101	471.598		ekiekiuk wall: meial Height: 3 stories, 50° 1(74'-8"
1,200 100 1,200 100 1,200 100 1,200 100 2,2000 15 2,4544 100 2,2444 100 2,2444 100 2,2444,100 2,			237,399	(15) MECHANICAL	-	25.47	25.47		11,881,321	GROUND FLR AREA: 185.	50 SF + RAMP & TUNN
100000 CT 10000 CT 10000 CT 1000 25 1000 25		· 	237.399	MITROGEN PIPING	1,850 LF	60.23	0.24	111.421		TOTAL PLR AREA: 400,508 SF + KAMF & IUNNEL 27.762 SF	1 SF + KAMP & IUNNEL 27.762 SF
25.000 LF 25.000 LF 45.44 TON 22 3.654 TON 22 1666 TON 2 280 TON 3 400 EA 40 EA			237,399 9,792,395	PLUMBING 28 500 LF	166 FX	7,151.55	2.53	1,180,006			436,025 CI
4544 TON 2 4,544 TON 2 4,544 TON 2 3,634 TON 2 166 TON 3 280 TON 3 40 EA 40 EA		<u> </u>	237,399	FIRE PROT. 450.466 SF	4.100 HD	223.42	1.8	916.024		DETICENT AIR CONDITIONED: 90%	10 000 SE 2,500 ION
4544 TON 2 4544 TON 2 3634 TON 2 166 TON 3 280 TON 3 460 EA 40 EA		<u> </u>	9,792.395	COMPRESS AIR 125 PSIG	3.761 LF	123.33	0.99	463.839		VVG 28" X 120"= 2,750 SI	
3.634 TON 2 3.634 TON 2 1.66 TON 3 2.80 TON 3 463,100 SF 3.61 UF 40 EA	┟╴	<u> ` </u> _		HVACIOHILLERS/AHU	2.500 TON	2,679.58	14.36	6,698,948		SPECIAL FEATURES	EATURES
2000 TON 1. 2000 TON 3. 2000 SF 3. 3.01 LF 46.	╏╼┠╼┠╼			DUCTWORK ALUM & GALV	442.127 LBS	2.56	2.43	1.132.763		CLEAR & GKUB ZU40 AC	JUICANE NE 2-00 101
260 TON 3. 260 TON 3. 361 LF 40 EA	\bot	_		SOLE SOURCE CHILLER	2,500 TON	489.69	2.62	1.224.231		STRUCT. STL 2.161 TON OPR FOOT PRINT & EA	OPR FOOT PRINT & E
463,100 5F 361 UF 361 UF	1_	5 1 003 236		20 HP/5500 RPM						SPRAY FIRE PR. 94 SF	ALL BEAKING COMPAI- IN FROOD 143 MIL
361 40 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5				COMM VACUUM SYS.	6.200 LF	24.85	0.33	154,089		ELEVATORS 94320 EA	COOL TOWER 2.3 N
40 EA					25,000 KVA		14.31		6.675.664	LIGHT FIX 44 82 EA	GFE 1.001.436
5	589.65 0.05	2	23.586 1	UCHT FIX & LAMPS	17,196 EA	4 4 .82	- 9	770.799		CONSIRUCTION BID DAT (IFB10-005-0)	
	509.65 0.05	5 23.586		LIGHTINING PROT & GRND	436 ROD	Ĩ	0.51	240,046			785 32,036,77
5	_		2.726.373	CABLE TRAY	15.000 LF	21.05	0.68	315.736			1831
307.400 SF	1.12 0.74	4 345,234		EXTERIOR SVCS	25.000 KVA	94.38	5.8	2.359.422		INTERIOR ELEC 14.31	/BSF 0,0/0,004
204 4AD SF	 _	_		ANTENNA & COMM SYS.	7.210 LF	16.21	0.25	116.866			122
2011 133.672 55		1		FIRE ALVAMS	286 DET.	-	062	288.905		E HISNOO	
526.402 SF	_			COND WIRE CABLE RECPT	48.850 LF	21.53	2.25	1.061.530			/83F
IA TAR IF		L		X-FORMERS/PANEL BD	174 EA	6.739.66	2.51	1,172,700		PROJ EST	/85- 56,861,963
DOW 907 EA 1.6			1,505,428	MOTOR CONTROL CENTER	9 EA	35,974.89	0.69	323.774		BID DATE: 1-23-91 /	1-23-91 AWARD DATE: 2-15-91
380 EA		6 213.832		COMPLEX CONT. SYS	6.700 LF	5.36	90.0 10	35,886		CONSTRUCTION TIME SPAN	TILE SPARE TUBU CALENDAYS
AL DOORS 4.150 SF		 		RED FURN. COMM. ELEC.	466.558 SF	8.72	8.72		4.070.393	NO OF BLODERS: 9 POS.	DF GOV EST 2 OF 9
884 EA				S.S.PROCESS FAC TSK I	466,558 SF	111.96	111.96		52.233.901)] PERCENT DIFFERENCE AWARDED BIU & +1.14.8 	SCHED, COMP. DATE 4/1/94
18 767 SF	13.70 0.55	5 257,157		HVAC CONTROL TASK II	18,450 I LF	19.18	0.76		353.824	coc	
ADE SFIS	1_			PREMISE WIRE TSK III	1.025.020 LF	1.72	3.79		1,766.968		56.215.000
407 55		L		SECURITY SYS TSK IV	39,250 LF	2.52	0.21		98.956	GOV'T ESTIMATE	56,861,9
2.285.407 SF	_		4.000.454	EWARON MONITOR TSK V	32,040 LF	1.72	0.12		55.237	WAL CONSTRUCTION	57,585,0 58,798,0
AT BACK 474.320 SF	3.54 3.60	0 1,680.870		TOTAL BASE BID INCL. T	ASKI-V		116.83		54,508,886	-CENTEX-ROONEY	59,170,000
336 230 SF			82					• ADUUSTED		SOVRAN CONST., INC.	59,950,5 0,001,05
351 500 SF		L		NEW CHILLER TSK VII	2.450 TON		3.72	1.363.655)	1,735,898	WALSH CONST.	62.242.8
1 103 250 55		1_		POWER FEEDER ISK VI	24.500 LF	25.19	1.32	-(337,806)	617.199	MORRISON KNUDSON	70,761,0
5	1	\downarrow		*PROJECT TOTALS	466.558 SF		121.88		56.861.983	INCLUDES CAFETERIA, WG, TUNNEL & HALLITEMS	L' TUNNEL & HAU LIENS

HOW THE SSPF LOW BIDDER GOT LOW - CONSTRUCTION METHODS, ESTIMATING, BIDDING AND COMPUTERS

1 2

1. Used money saving systems - the Horizontal Dewatering System with direct burial, D/S Corrugated Plastic UG Piping System with special filters and pumps (to be used for future irrigation/sprinkler by NASA). Provided a clear and safe site, saves pulling out old weld point system.

2. Built prototype prefabricated forms for tunnels (1400 LF 25'x12'x14' +).

3. Used roadway vibrations roller compactor between piers - 700 c.y./day versus walk behind roller of 100 c.y./day.

4. Made building zone markers 1 - 24 and A - P. Site layout and work references, same as structural design drawings.

5. Planned to use Value Engineering (VE) proposals to increase profit.

6. Installed a satellite dish antenna receiving and transmitting at SSPF site for communication, payroll, labor reports, invoices, etc. Saved money over long line lease.

7. Computer estimating and bidding:

a. Used Timberline Computer Estimating System which is faster and better. It lets them bid and get more jobs.

b. Used Primavera Plan Schedule Computer System.

8. Metric's capability to do their own mechanical work in-house, which got them better sub bids.

9. Want to bid other KSC work, need more jobs.

10. Used process industry experience to get extra good quote from process industry.

BASED ON NUMBER OF BIDDERS* MEAN ACCURACY OF GOVERNMENT ESTIMATE

BASED ON OUR EXPERIENCE AND APPLICATIONS OF NUMBER OF BIDDERS CHARTS IT IS SUGGESTED THAT INCREASED BID COMPETITION LOWERS THE BID COST 7% TO 22% AS NUMBER OF BIDDERS INCREASES OVER 7 BIDDERS

NO. OF BIDDERS	NO. OF PROJECTS	MEAN ACCURACY (%)	MEAN ABSOLUTE (%)	STANDARD DEVIATION
2	1	4.53	4.53	0
3	4	- 3.24	9.70	11.20
4	10	- 1.73	11.77	15.21
5	10	- 7.02	18.19	24.66
6	11	- 8.51	13.41	14.80
7	6	- 27.86	27.86	20.01
8	9	- 20.72	20.72	28.65
9	8	- 20.93	23.33	28.26
10	l	- 5.41	5.41	· 0
11	2	- 12.42	15.09	21.33
13	2	- 13.81	18.93	26.76
15	1	- 22.66	22.66	0

FIGURE IV

* From Dr. R. M. Skitmore's Factors Affecting Accuracy of Engineering Estimating

HOW THE GOVERNMENT ESTIMATE FOR THE SPACE STATION PROCESSING FACILITY WAS SO ACCURATE

1. Team work effort between the NASA Lead Design Engineer, Design Engineers, Civil Servants and Lead Cost Engineer, etc., and the rest of the team which consisted of A&E's -Jacobs Engineering Group, Inc. and Ralph Hahn and Associates, Inc., McDonnell Douglas, Support Contractors - EG&G, Lockheed, McDonnell Douglas, Vendors, Suppliers and Sub Contractors

2. Lots of cost estimating over 15 separate estimates, since 1983 from many concepts, budgets, PER, Preliminary 30, 60, 90, 95 and Detail C100 - Final Government Estimate

3. Vendors, suppliers and sub contractors - budget quotes for estimating over 400 quotes

4. KSC Cost Engineering System - Cost Data

- Estimating Specifications G0002 and G0003
- Cost Index 1974 Present
- Special Cost Engineering Summaries L&M, System, Budget Comparison
- 3 Volume Price Books
- 17 Other KSC Cost Estimating Tools (see Aerospace Construction Cost Estimating Technical Paper, 1st World Cost Engineering Congress, July 1, 1992
- Continuous Developing and Testing New Estimating Tools such as Fiber Optics and Pneumatic Panels (see Chart 8 - New Exciting Tools).
- 5. High Bid/Medium Bid/Low Bid Analysis See part II of Budget Comparison

Summary

6. Bidder Analysis based on number kind and type of potential bidders:

a. Source list of bidders that got the SSPF Plans, Specifications and IFB (over

945 Bidders)

b. Pre Bid Conference - 14 page list of bidders

c. A Survey of local Print Shops - Full Size Drawing Requests at \$580 a set, list of bidders getting drawings.

d. Questions from bidders, prime and subs, etc. - 725 questions from bidders including - 10 Primes

e. Dodge Report list of 10 primes receiving sub bids

f. Open Shop versus Closed Shop

g. Accuracy of government estimates based on 900 bid projects over 6,000 bidders. Low bidders averaged 8.4% under the government estimate at KSC. High bidders averaged 32% over the government estimate.

h. Accuracy of government estimates based on number of bidders (University of Salford Study)

i. Construction Market condition at bid opening

7. Computer Analysis - what if - overhead, profit, volume discounts by Lead Design Engineer and Lead Cost Engineer (PACE 27)

8. Lots of extras, good hard detailed estimates and analysis, work by team

9. Planed and scheduled analysis based on limited three (3) year funding - construction etc.

10. Management policy was to get the best and most accurate government estimate possible

11. Cost trend analysis throughout design

12. Excellent detail labor and material quantity take off, correct quantities with very good unit prices.

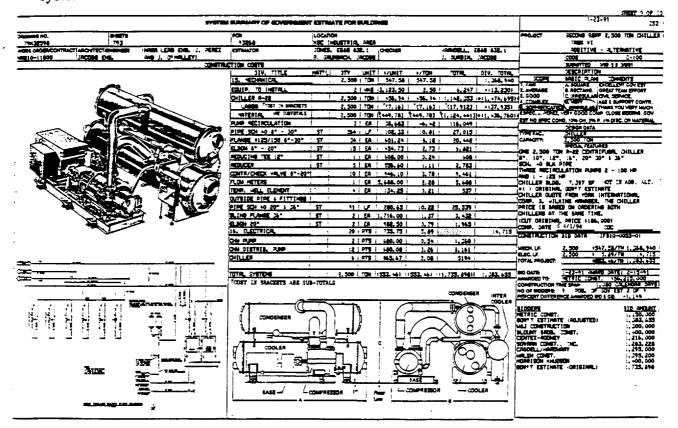
13. Fine tuning PT&I rates especially civil, mechanical, and electrical.

14. Accurate estimates for design changes throughout design

15. Managements strong support to allow internal technical cost expertise to influence and override independent A&E cost estimates

ENERGY COST SAVING

See System Summary of additive alternates for the 2,500 ton chiller. This summary was used in the submittal to Florida Power and Light for energy cost saving credit of \$350,000. The central chilled water distribution system for the KSC Industrial Area with additional energy cost savings is estimated at over \$150,000 per year, plus increased efficiency and operation cost. Based on a 25 year life cycle and the present worth comparison this system will save more than \$5 million.



SUMMARY

The accuracy of the SSPF estimate proves the benefits of our Kennedy Space Center (KSC) teamwork efforts and KSC Cost Engineer Tools which are contributing toward our goals of the Space Station.

ORIGINAL PAGE IS OF POOR QUALITY

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19. Brown, J. A. 1973. How Does the Successful Low Bidder get Low and Make Money?, AACE 17th Annual Mtg, St. Louis, MO.

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17

New Exciting Estimating Tools

As a part of DE cost engineering continuous improvements, some new exciting aerospace construction and GSE cost estimating tools are being developed and tested at KSC:

- 1. Fiber Optics Cable Cost per fiber foot/meter John Shramko and Bob Lupo/DF-FED-22, Joseph A. Brown/DF-FED, Lashanda Gantt/DF-FED-2, Austin Durette/EG&G (Page 1B).
- 2. Cost Per Panel Component Chart Labor, Material & Fabrication For Budget and Cross checking Etheroy Jones/EG&G, Joseph A. Brown/DF-FED (Page 1C).
- 3. Chart Cost Per Panel Component Only Kim Ballard/DM-MED-42 (Page 1D).
- 4. CAD/Automatic Cost Estimating Joseph a Brown/DF-FED, Hank Perkins/DL-DSD-22.
- 5. Work Hours Per Panel Component Chart and Summary Analysis Joseph A. Brown/DF-FED, Etheroy Jones/EG&G (Page 1E).
- 6. Chart for Detail Estimating Pneumatic and Hydraulic Panels and Tubing Work Hours and Materials - Etheroy Jones/EG&G, S. Thomason/PRC, Joseph A. Brown/DF-FED (Page 1F).
- 7. Work Hours for Welding SS Tubing-Astro Heliarc Welding Machine Etheroy Jones/EG&G, Joseph A. Brown/DF-FED (Page 1G).
- 8. OFE/GFE Estimating Cost for Handling, Storage, and Insurance, 1-10% Joseph A. Brown/DF-FED.

FROM: Joseph A. Brown

ORGANIZATION: DF-FED

EXT: 7-3268

1A

RICE BOOK 3/16/93 SHEET OF ROJECT/W.O. TITLE DRAWING NO(S) SHEET # 16906-8 INIT COST FIBER OPTIC CABLE (Per Fiber Foot) PCN SPECSINTACT INTON SET LOCATION SPECSINTACT 16906-8 STIMATOR CHECKER APPROVED JOE BROWN, DF-FED A.DUREITE, EG&G 832.1 C. PIERCE, EG&G 832.1 JOE BROWN, DF-FED HE FOLLOWING GRAPH IS BASED ON INFORMATION TAKEN FROM AWARD AMOUNTS OR CONTRACTS COMPLETE FROM 1980 THRU 1991 WITH FIBER COUNTS OF 10, 30, 36, 72 & 144 FIBERS YOTH SM & MM SM = Single Mode, MM = Multi Mode IN NON-PRESSURIZED & PRESSURIZED AND GELL FILLED AMM SM = Single Mode, MM = Multi Mode IN NON-PRESSURIZED & PRESSURIZED AND GELL FILLED ABLE SYSTEMS AND TESTED AT THE FOLLOWING WINDOWS Test 1. 850/1300 Test 2. 1550 um WINDOWS. * ALL NEW SYSTEMS ARE BEING TESTED AT 1300 & 1500 WINDOWS ** CONTRACT # DATE BID AWARD AMOUNT TOTAL FIBER FT. COST PER FF CABLE SIZI 1026 12/83 * 148,230 317,500 \$0.47 10 PRESS 1329 1/86 1,043,261 7,262,100 \$0.14 36 & 72 1445 9/87 303,168						
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STIMATOR CHECKER APPROVED ADURETTE, EG&G 832.1 C. PIERCE, EG&G 832.1 JOE BROWN, DF-FED ADURETTE, EG&G 832.1 C. PIERCE, EG&G 832.1 JOE BROWN, DF-FED CHECKER JOE BROWN, GAPAH IS BASED ON INFORMATION TAKEN FROM WARD AMOUNTS STIMATOR CONTRACTS COMPLETE FROM 1980 THRU 1991 WITH FIBER COUNTS OF 10, 30, 36, 72 at 144 FIBERS STIMATOR ONTS MA SMB Single Mode, MM – Multi Mode IN NONNPESSURIZED A PRESSURIZED AND GELL FILLED AND REFERED AT THE FOLLOWING WINDOWS Test 1, 850/1300 Test 2, 1550 um WINDOWS. ALL NEW SYSTEMS AND DESTED AT THE FOLLOWING WINDOWS Test 1, 850/1300 Test 2, 1550 um WINDOWS Test 1, 050/1300 Test 2, 1550 um WINDOWS TEST 0, 051/4 10 PRESS T026 12/83 148,230 317,500 \$0.47 10 PRESS T0302, 160 889,308 \$0.34 36 & 72 1445 9/97 303,168 889,308 \$0.34 36 & 72 1445 9/97 303,168 889,308 \$0.20 72 1445 9/97 303,168 89,308 \$0.20 72 144 172 1/28 1/27 1/28 1/27 1/28 1/27 1/28 1/28 1/28 1/27	STATION SET	LOCATION			PCN	
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HE FOLLOWING GRAPH IS BASED ON INFORMATION TAKEN FROM AWARD AMOUNTS OR CONTRACTS COMPLETE FROM 1980 THRU 1991 WITH FIBER COUNTS OF 10, 30, 36, 72 & 144 FIBERS ONT SM & MISM = Single Mode, MI = Multi Mode IN NON-PRESSURIZED & PNESSURIZED AND GELL FILLED ABLL ESYSTEMS AND TESTED AT THE FOLLOWING WINDOWS *** CONTRACT # DATE BID AWARD AMOUNT TOTAL FIBER FT. COST PER FF CABLE SIZI TATE BID AWARD AMOUNT TOTAL FIBER FT. COST PER FF CABLE SIZI TATE BID AWARD AMOUNT TOTAL FIBER FT. COST PER FF CABLE SIZI CABLE SIZI TOTAL FIBER FT. COST PER FF CABLE SIZI CABLE SIZI TOTAL FIBER FT. COST PER FF CABLE SIZI CABLE SIZI TOTAL FIBER FT. COST PER FF CABLE SIZI COST COST GRAPHING SIZE PIPST SIZE SIZE TIST J/86 TOTAL FIBER FT. COST GRAPH SIZE SIZE SIZE J/86 TISTED AT THE FOOT SIZE TISTED AT TRACT ONLY SIZE SIZE SIZE J/86 <tr< td=""><td>STIMATOR</td><td></td><td></td><td></td><td></td><td></td></tr<>	STIMATOR					
OR CONTRACTS COMPLETE FROM 1980 THRU 1991 WITH FIBER COUNTS OF 10, 30, 36, 72 & 144 FIBERS ODTH SM & MM & Single Mode, MM = Multi Mode IN NON-PRESSURIZED & AND EQLL FILLED ABLE SYSTEMS AND TESTED AT THE FOLLOWING WINDOWS Test 1, 850/1300 Test 2, 1550 um WINDOWS. * ALL NEW SYSTEMS ARE BEING TESTED AT 1906 A 1500 WINDOWS ** ONTRACT W DATE BID AWARD AMOUNT TOTAL FIBER FT. COST PER FF CABLE SIZI 1026 12/03 * 144, 230 * 317,500 \$0.47 10 PRESS TB 10-0113.4 SUPPLY CONTRACT ONLY 9/84 463,302 2, 105,918 \$0.22 30 O PRESS TB 10-0113.4 SUPPLY CONTRACT ONLY 9/84 463,302 2, 105,918 \$0.22 30 C PRESS 11229 17/86 1, 1043,261 7, 262,100 \$0.14 36 & 72 1445 9/87 303,168 899,308 \$0.34 36 & 72 1587 3/89 340,937 1, 566,124 \$0.22 36 & 72 1587 3/89 340,937 1, 566,124 \$0.12 36 & 72 1587 3/89 340,927 1, 566,124 \$0.14 72 & 144 1725 4/90 698,625 6, 218,244 \$0.11 36 72 & 144 1725 7/80 534,000 2, 2635,072 \$0.20 36 72 & 144 1725 7/80 534,000 2, 2635,072 \$0.20 36 72 & 144 1834 5/91 899,557 4, 756,680 \$0.19 36 72 & 144 1891 12/91 1,249,990A 9, 7/86,420 \$0.13 36 72 & 14 1891 12/91 1,249,990A 9, 7/86,420 \$0.13 36 72 & 144 200E 3/93 867,677A 7, 274,400 \$0.1193 72 144 & 21 FTIELER FOOT COST GRAPH \$0.10 11/92 1,473,393A 7,424,220 \$0.145 36 72 & 14 200E 3/93 867,677A 7,274,400 \$0.1193 72 144 & 21 SUMMARY ANALYSIS: AWARD AMOUNTS WITH THE LETTER A, INDICATE COST ADJUSTED FOR FIBER ONLY. SMALL JOBS 1,50 TO COST GRAPH \$0.10 11/92 1,00 FIBER FEET COST BETWEEN \$3.4 \$5.0 PER FIBER FOOT. LARGE JOBS 5 MILLION & CORT REFET COST BETWEEN \$19 \$,52 PER FIBER FOOT. SUMMARY ANALYSIS: AWARD AMOUNTS WITH THE LETTER A, INDICATE COST ADJUSTED FOR FIBER ONLY. SMALL JOBS 1,5 TO 4 MILLION FIBER FEET COST BETWEEN \$19 \$,52 PER FIBER FOOT. LARGE JOBS 5 MILLION & CORT REFORT SOT BETWEEN \$11 \$,515 PER FIBER FOOT. SUMMARTION: DUE TO ECONOMY OF SCALL, LARGER JOBS ARE MORE COST EFFECTIVE. SIMMARTION: DUE TO ECONOMY OF SCALL, LARGER JOBS ARE MORE COST EFFECTIVE. SUMMARTION: DUE TO ECONOMY OF SCALL, LARGER JOBS ARE MORE COST EFFECTIVE. SUMMARTION: DUE TO ECONOMY OF SCALL,	.A.DURETTE, EG&G 83	2.1				DF-FED
ONTHACT # DATE BID ANALORMUCT TOTAL DATE OF THE ALL OF THE	FOR CONTRACTS COM BOTH SM & MM SM = Sin CABLE SYSTEMS AND T	PLETE FRO ngle Mode, I TESTED AT	M 1980 THRU 1991 WITH MM = Multi Mode IN NON- THE FOLLOWING WIND TESTED AT 1300 & 1500	H FIBER COUN PRESSURIZED OWS Test 1.85 WINDOWS **	TS OF 10, 30, 36 & PRESSURIZI 0/1300 Test 2. 1	550 um WINDOWS.
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SUMMARY ANALYSIS: AWARD AMOUNTS WITH THE LETTER A, INDICATE COST ADJUSTED FOR FIBER ONLY. SMALL JOBS LESS THAN ONE (1) MILLION FIBER FEET COST BETWEEN \$.34 - \$.50 PER FIBER FOOT MEDIUM JOBS 1.5 - TO 4 MILLION FIBER FEET COST BETWEEN \$.19 - \$.22 PER FIBER FOOT. LARGE JOBS 5 MILLION & OVER FIBER FEET COST BETWEEN \$.11 - \$.155 PER FIBER FOOT. SUMMATION: DUE TO ECONOMY OF SCALE, LARGER JOBS ARE MORE COST EFFECTIVE. DIRECT BURIED / PLOWED, APPEARS TO COST APPROXIMATELY THE SAME AS, OR LESS THAN CABLE PULLED IN DUCT BANK IN INNERDUCT.		٣.				JOBS
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SUMMARY ANALYSIS: AWARD AMOUNTS WITH THE LETTER A, INDICATE COST ADJUSTED FOR FIBER ONLY. SMALL JOBS LESS THAN ONE (1) MILLION FIBER FEET COST BETWEEN \$.34 - \$.50 PER FIBER FOOT MEDIUM JOBS 1.5 - TO 4 MILLION FIBER FEET COST BETWEEN \$.19 - \$.22 PER FIBER FOOT. LARGE JOBS 5 MILLION & OVER FIBER FEET COST BETWEEN \$.11 - \$.155 PER FIBER FOOT. SUMMATION: DUE TO ECONOMY OF SCALE, LARGER JOBS ARE MORE COST EFFECTIVE. DIRECT BURIED / PLOWED, APPEARS TO COST APPROXIMATELY THE SAME AS, OR LESS THAN CABLE PULLED IN DUCT BANK IN INNERDUCT.		986 1987	1988 1989 2/90 4/	90 7/90 5/9	1 12/91 11/92	•
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ESTIMATOR				CHECKER				APPROVE	ED	
E. JONES,	EG&G	832.	1	VARNDEL	-					
BJBCPC	<u> </u>		THE GRAPH IS BASED	ON COM		TS TAKEN COST PER	FROM GC	MHRS PER	LOW BIDDER	
		DATE	NAME OF PANEL	GOV. EST.	NO, OF COMP.	COMP.	COMP.	PANEL	COST	REMARKS
CONTRACT		DATE		71,521	36	1,987	29	1,049	66,267	ELECTRICAL
IFB-10-0124			GN2 ECLSS SERVICE	i	154	1,309	13	** 1,992	175,349	**ADJUSTED
IFB 10-0045	-1 3-11	-81	MMH PRESS. PURGE	201,626				1,772		
				(106,555)		1,544		1.042	09.370	
NAS10-1171	1 5-8-	90	BREATHING AIR (3 EA)	48,825	* 69	708	18	1,243	28,379	
				(47,490)		1,397				
NAS10-1171	1 5-8-	90	GN2 PANEL	23,705	* 34	697	19	653	26,512	
NAS10-1194	9 9-14	-92	REGULATOR PANEL	60,187	52	1,157	12	623		BREATHING AIR
NAS10-1194		1-92	CHARGING PANEL	11,751	9	1,306	16	145		IS REGULATED
NAS10-1194			EXT. MANIFOLD (3 EA)	9,603	6	1,601	31	185	8,070	FRM 2,400 PSIG
NAS10-119			INT. MANIFOLD (9 EA)	22,608	18	1,256	25	446	21,510	TO 60 PSIG
			TEST MANIFOLD (6 EA)	5,778				125	6,720	
NAS10-119			MORTALITY SPARES	35,710	28	1,275	1	1	· 4,613	MATERIAL ONLY
NAS10-119				32,799	35	937	1		39,637	MATERIAL ONLY
NAS10-119			INITIAL SPARES		441	<u>,,,,</u>	15	6,461		
			(26 PANELS)	524,113	441	1 100	+ ¹³	0,401		
			NEL & COMPONENT	20,158	<u>-</u> -	1,188		0.40		
			& MHRS PER PANEL	<u> </u>	17	L	15	249	J	L
			VE, FILTER, GAUGE, SW							
TUBING AN	ID KC FI	TTING	S ARE GEE TO THE CON	TRACTORS	- NOT A	DJUSTED	FOR ESCAL	ATION		
			COST PER C	D HOURS		, HOU	RS PEF	< PANEL	-	
	2.2	-	AN	U HOURS	PER GO	ME ONEN				<u> </u>
ļ	2		ч. /	· · · · · · · · · · · · · · · · · · ·						
	1.8									
2	1.6		-X +					······································		
R PAK	1.4				_					
전 <u>축</u>	1.2	————	-/ <u>-</u> -					$\overline{}$		
DOLLARS AND HOURS FOR PANEL (Theuronds)	1		<u>+</u>		<u> </u>			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
3ē	0.8									
EL ME	0.6									
8	0.4									
	0.2			····						
	0	ļ		<u></u>			-		*	
	-0.2	<u> </u>		1992 -		992 FM	1992		COMP	J
ļ		1	950 1990 BA 1951 - 1990	0N2 1	192 CH	AR 19	92 IM	1992 18	AVO PANEL	
	•		PONENT COST		B PÉR I				DMANIFOLD	
			EG - REGULATOR, CHAR	- CHARGIN	G, EM - E	XTERIOR	MANIFOLD,	IM - INTERIO	H MANIFOLD	
			ES, IS - INITIAL SPARES GFE TO CONTRACTOR							
	21113 4					1C		γ P		· · · · · · · · · · · · · · · · · · ·
			DAGE	19				Dec 196	e 25 220 457=n Sui	
			1-0-					ranels J	422-201	MANY "

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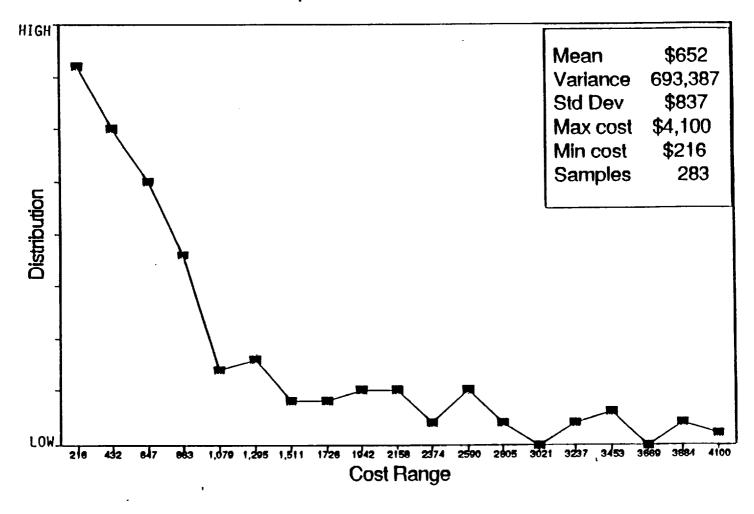
^{19 10}

15100-24 SHEET 11 OF 11 SPECSINTACT 15100

MATERIAL ONLY, FROM MDSSC KIMS

FLUID COMPONENTS: Valve, Filter, Gage, Switch, Transducer, Orifice and Silencer

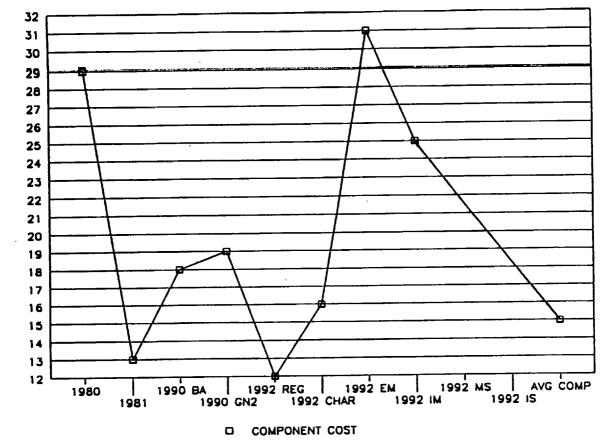
Pneumatic Panel Component Cost Distribution



Per Kim Ballard MD-MED-42 Telephone No. 867-3266 Date Nov. 19, 1992

HOURS PER COMPONENT

HRSCOMP



SUMMARY - ANALYSIS OF PNEUMATIC PANEL COST

- 1., Average cost per component is \$937 to \$1,987; to be used for budget estimate and cross check detail estimate.
- 2. Concerning escalation 1980-1992; little or no escalation. May have gone down slightly due to learning curves, experience, material cost flat or decreasing.
- 3. Electrical/Mechanical type panel cost more than mechanical panel only.
- 4. Be aware of GFE component cost as they affect average panel.
- 5. Tubing and KC Fittings are assumed GFE in all cases.

HOURS

- 6. Budget estimating cost for panel is \$10,000 through \$360,000; still being evaluated.
- 7. Increase size of tubing, fittings and component will cost more; normal size 1/4" to 1" with few 1-1/2" and 2".
- 8. Panels are fabricated, tested, and cleaned in the shop and delivered to KSC, no bond or sales tax.

4 8 93 REVISED 4-23-92

SPECSINTACT. 15066

ESTIMATING MANHOURS FOR STAINLESS STEEL TUBING PNEUMTIC AND HYDRAULIC PANELS & LONG TUBING RUNS

\$ 24.35

MANHOURS SHOP RATE FOR PANELS - \$20-\$25/HR--MANHOURS FIELD RATE FOR LONG RUN - \$23-05/HR

KC106 - Re KC150 - Ca KC115 - Bu KC143 - S1	iucer p shing		FINGS KC130 - Pl KC112 - Ni KC142 - Nu KC164 - Bu	pple t	Herkirmen Schedule units, p	r" p. 79, Ta 10, use one lus fitting	ble 54 - half lab & extra t	e assembly, see Ell & tees - oor manhour cesting. For , use table as
			ong Runs*					STEEL TUBING ING, BENDING
	ABOVE KC FITT.	UNI		TEE CROSS			TUBE <u>Assy*</u>	<u>TUBE-LONG</u> RUN PLUS SPEC FITTINGS
SIZE	HR/EA		A HR/EA	HR/EA	SIZE	WALL THICK	HR/EA	HR/LF
C4 = 1/4"			.4896	.36				
C6 = 3/8"	.14		.56-1.12		1/4			
C8 = 1/2"	.16	. 32	.64-1.28		3/8		2.78	
C12 = 3/4"	.21	. 42	.84-1.68	.63	1/2			. 14
C16 = 1"		.50	1.00-2.00	.75	3/4			
$c_{20} = 1 - 1/$.60	1.20-2.40	.90	1-	.095"	5.48	
C24 = 1 - 1/		.70	1.40-2.80		1-1/4	.049"	6.56	.28
C32 = 2-"		.88	1.76-3.52	1.32	1-1/2		7.64	. 32
					2-	.065"	8.88	.37
*On Long R (less han		r may	be cut in	half	*Include	s Labor for	two nuts	and two sleeves

Add for cleaning - KSC-SPEC-123 - Levels 100, 200, 300, Visual Clean; hangars; Supports; Testing; Electrical Cables & Distribution; Checkout; Validation; Current Material Prices.

Face Plate A-36 Fabricate Panel Face Plate and Bracketry Labor: Use .12 TO .22 HR/LB.

Framing steel A-36 Support Frame Steel: Use .07 HR/LB. Paint steel: Use .02 to .05 HR/SF, 15 to 25 CENT/SF

SIZE	LOCK NUTS	2/11/92 **MAT. COST	Panels Accessory Labor & Mat	<u>terial</u> LAB/HR	UNIT	MAT.
1/4"	AN924-4K	\$.85	Panel Label	. 50	ea	\$.30
3/8"	AN924-6K	.95	Ident. Plate Plastic	.50	ea	.20
1/2"	AN924-8K	1.75	Band Marker 75M04185*	.10	ea	.40
3/4"	AN924-12K	2.85	Coat Tubing w/AR-7	.05	1f	.12
1-"	AN924-16K	4.10	Corrosive Protection			
1-1/4"	AN924-20K	15.00	Clean Tube Assy-Level 300	1.00	ea	4.00
	AN924-24K	17.00	Clean Component-Level 300	1 to 3	ea	4.00
2-"	AN924-32K	32.50	Color Code	.03	1f	.04
			75M02048-1-Bleed Fitting 3/	8" .14	ea	\$175.25
			79K80456-Supersedes 75M0204			
			Leak Test Panel 15 hr ea			
**Mat C	ost Based on	Ouan, 100	*For Each Tube Assembly	•		

See Panels Section 13F in Aerospace Price Book for Sample. Adjusted for Aerospace Quality, Tolerance, Cleaning & Testing, etc. Reference 4 "Herkirmer" - Cost Manual for Piping Mechanical Construction. Tables 66 & 68, pp. 93 &

ESTIMATER: Etheroy Jones In. PAGE

CHECKE 1F

SPECSINTACT 15066-1A

ESTIMATING MANHOURS FOR WELDING STAINLESS STEEL TUBING AND FITTINGS USING ASTRO HELIARC WELDING MACHINE

5066

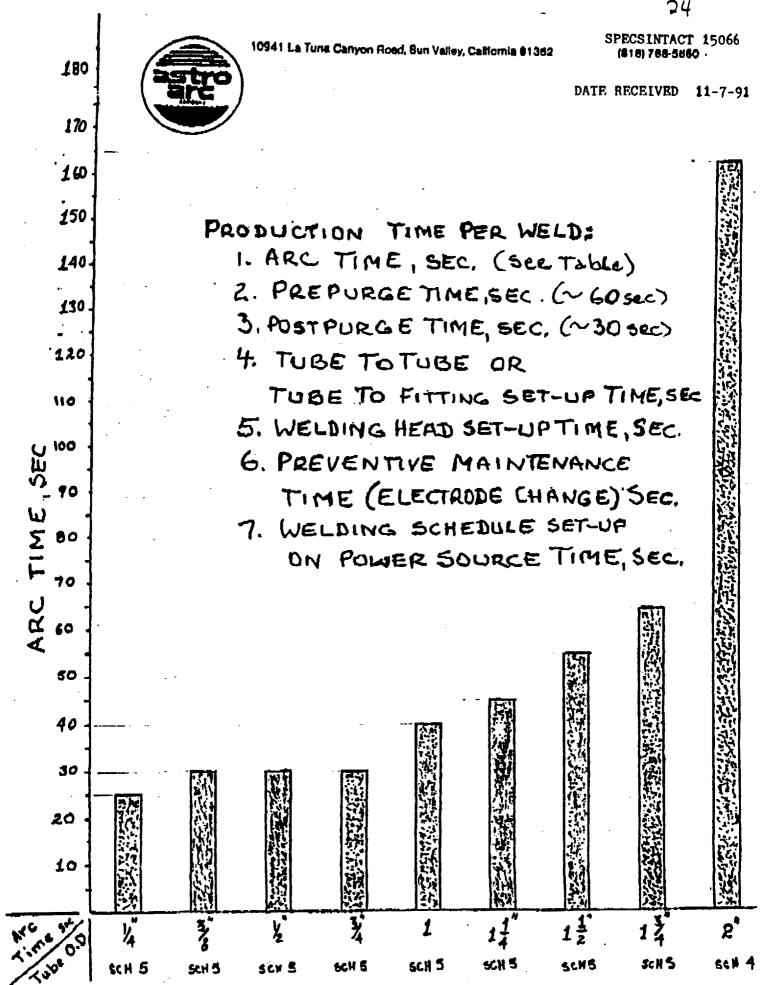
W TEE CROSS 0.98 1.33 1.00 1.35
0.98 1.33
1.00 1.35
1.34 1.84
2 1.39 1.91
1.45 1.96
1.64 2.14
1.90 2.51
2.20 2.87

LABOR HOURS ARE AVERAGED FROM HERBERT HERKIMER COST MANUAL 1958 PAGES 77 AND 79, TABLES 52 AND 54, 1/2 THE LABOR FOR SCHEDULE 10 OF STAINLESS STEEL BUTT-WELD PIPE AND FITTINGS, MEANS MECHANICAL COST DATA 1991 SCHEDULE 5 ON PAGES 78, 79 AND 80 AND ASTRO ARC SYSTEM OF PAGE 30B

BUTT-WELD TUBING PER LINEAL FEET AVERAGE TWO WELDS PER 20 FEET WITH MARK-UPS OF \$24.00 HOURS, 26% P.T.&I., 15% OVERHEAD, 10% PROFIT, 10% PRIME MARK-UP AND 1% BOND.

	1.27		TOTAL		MARK-UP (\$)
SIZE	LF	WELD-LF	(MH)		
1/4"	0.16	0.04	0.20	X MARK-UPS =	8.50 LF
3/8*	0.16	0.04	0.20	X MARK-UPS =	8.50 LF
1/2"	0.19	0.05	0.24	X MARK-UPS ≖	10.20 LF
3/4"	0.21	0.06	0.27	X MARK-UPS =	11.47 LF
1"	0.24	0.07	0.31	X MARK-UPS =	13.17 LF
1-1/4"	0.27	0.08	0.35	X MARK-UPS =	14.87 LF
1-1/2"	0.29	0.09	0.38	X MARK-UPS =	16.15 LF
2"	0.36	0.10	0.46	X MARK-UPS =	19.55 LF

SCHEDULE 5 ON PAGE 75. ADD PRICE FOR TUBING.



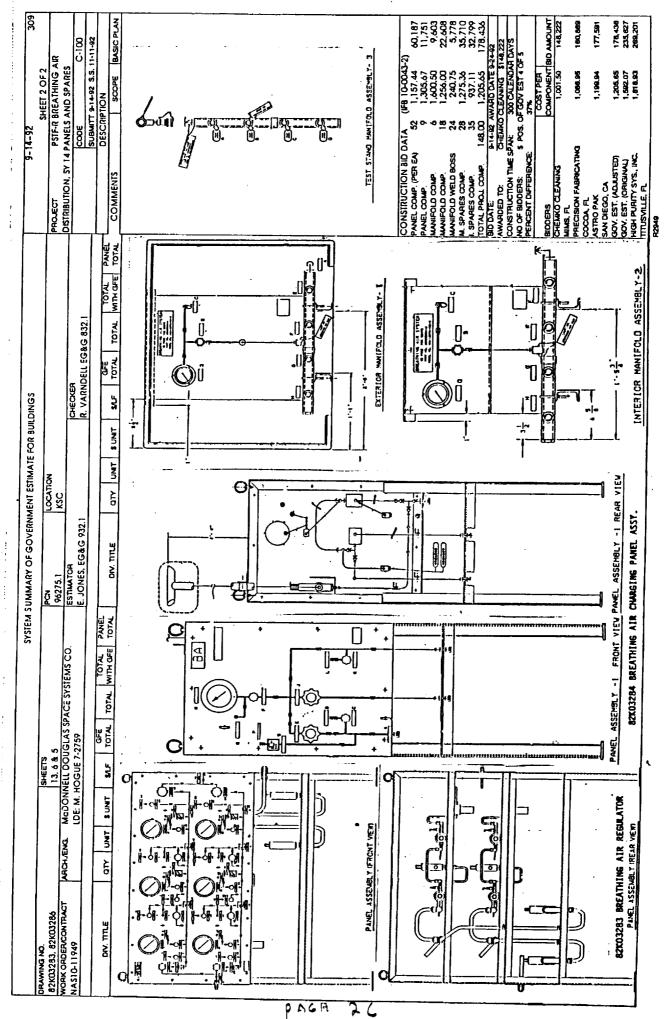
							SYSTEM SU	SUMMARY OF GOVERNMENT ESTIMATE FOR BUILDINGS	MENT EST	MATE FC	VICTIN8 24	GS				9-14-92	
DRAWING NO. 82K03283, 82K03286			SHEETS 13. 6 8	15				PCN	LOCATION	7						SHEET 1 OF 2 PROJECT PSTEID RDFATHING AID	SHEET 1 OF 2
WORK ORDER/CONTRACT	ACH/ENG	Ι.	ONNELL C	OUGLA	S SPACE	MCDONNELL DOUGLAS SPACE SYSTEMS CO	0	ESTIMATOR) XX		Ī	Cucreto C				TION, SY 14	SPARES
NASILIARY			LDE: M. HOGUE 7-2759	E 7-2759				E. JONES, EG&G 932.1			5 ~	R. VARNDELL EG&G 832.1	. EG&G 8	32.1		CODE CODE C-100	C-100
אחה שם	~~0	TWT	⊢	GFE		TOTAL				╞	_	GFE			0,110	DESCRIPTION	
BREATHING AIR PANEL SCICIDAS	1	-			-				Ę	근	\$ UNT	-	TAL TOTAL	3			SCOPE BASIC
FACE DI ATE A EDAME				-			8,18	<u>ष</u>	s	_	41.40 3	34.50		207		STOK. 701, MANIFOLD & MORT.	OCTAINST. D. VERY
PEGULATOD LAP & LEP		-	3.71 2/.00	9	2.152	8 !		TEST MANIFOLD	-	EA	58.00	9.67		8		SPARES TOO HIGH \$50,000	
VALVE SHITCELEAEDVICTIES		-T	00.041 52.	8	11,410	2		GFE FACTORS 3%		_			164	\$		2255.057 RECEIVED AFTER BID OPENIM	AG TOO LATE TO
PNEU FILTER	_	EA 040.11	CO 02 11	2	23.332	22		FREIGHT						8		DESIGN DATA	•
DOESE CALICE	-+-	-	-+-		2	S I		MANIFOLD 82K03286-2	2	LF 9@	_		5	2.512	22.608	1	A-36
TIDE ASSV 1145 TUDIET 1 14	0			_ _		_		PLATE & FRAME	23	18	6.17 28	28.40		142		THESE PARTS ARE NOT D CONTROL	
	_	8 5		-+-			5	1-1/4" PIPE/WELD BCSS	5	EA 12	123.00 12:	123.00	Ļ	615		PNEUMATIC FUNCTION 2 400 PSIG TO 60 PSIG	CUNTROL SO PSIG
Dent tack and we are		- .	_	89.		64 3.563	2	TUBE ASSY. 1/4"	3	EA 6	67.33 4C	40.40	14	202 216		SPECIAL TUBING MADE TO KSC SPEC-2.0007	2000-2
					2.708	8		KC FITINGS	23	EA	5.91 27	27.20 1	8	136 242		LIVERAL STAIN ESS STEET FITTINGS GEOOVED	
MISC. HAILUWAILE	-			9	8 8. 	8	_	SHUT-OFF VALVE 1/4"	-	EA 39	391.00 76	78.20	L			FOR KC103 SEAL RING	
CLEAN TUBE ASSY/COMPONENT	3	-+	Ŭ.	9	4.978	18	_	PRESSURE GAUGE	-	EA 21	214.00 42	42.80	Ľ	214		JEPECIAL COMPONENTS DESIGN FOR KSC	SC .
CE FANEL	-	EA 231.00	2.85	-+	_	231	_	Q/D/ SOCKET & CAP	8	EA 2	20.00 32	32.00	_	09		FILTER, SWITCH, TRANSDUCER, ORIFICE &	Se &
Gre racious			_	2.417		80		MISC. HARDWARE	8	EA	2.88 28	28.80	_	4		SILENCER	
ADEATUNC AD DAND 200000	-			-	-	8		DENT. TAG/LABEL/PLATE	18 (EA 1	12.28 44	44.20		221		BREATHING AR CHARGING PANEL	×;
A CT & ST & CONTRACT		-	-+-		╺╺╸		11.751	CLEAN TUBE ASSY/COMP.	4	EA 4	43.50 34	34.80	Ē	174		ECTERIOR MANEOLD	6,603
		+			<u>ج</u>	_		TEST MANIFOLD	-	EA S	58.00 11	11.60		88		TEST STAND MANIFOLD	9 **
VALVE-SHUTCH-F/SAFETY/CHECK			~		7.078	80		IGFE FACTORS 3%		_	-		120	5		MORTALITY SPARES	. 25
MEX. GAUGE		-+-	-+	_		2		FREIGHT			-	-	-	5		INTIAL SPARES IGFE TOTAL (TUBING & KC FITTINGS)	H `
1085 A327 1/5 1HRU 1-1/2		100.18	_1	3 185	5 1,201	1,386	\$	MANIFOLD 82K0328643	2	LF 6@				963	5 778	PROJECT TOTAL COST	-STB2
KC FITINGS	-+-	-	49 14.93	3 374		18 822	2	1-1/4" PIPE/WELD BOSS	4	EA 12:	123.75 247.50	8		405			
DENT. TAG/LABEL/PLATE	-+	_	12 17.37	_	521	-		Q.D. SOCKET & CAP	8		20.00 80	80.08	-	5		ะ ส	
VISC. HARDWARE		_			4	A		KC FITINGS	8	EA	- I		13	60 110	.		1,305.67 11
CLEAN TUBE ASSY/COMPONENT	19 EA	+			6	7		IDENT. LAG/LABEL/PLATE	1	F	1					5	
TEST FANEL	⊻ -	116.00	3.87	_		•		MISC. HAROWARE	89	EA	3.75 15	15.00	_	8		MANFOLD WELD BOSS 24	240.75 5,778
de racionada ábeicur	+	-	+	220		20		CLEAN MANIFOLD	- -	EA 6:	63.00 31.	31.50		3		ន	_
MANIFOLD ROWNDAAL1	3 V			_	8			TEST MANIFCLD	1	EA 29	29.00 14.	14.50		29		- 6	<u>ا ا</u>
3 4 16 & CD 4 16	-+-	2	-		1.201		9,603	9.603 IGFE FACTOR 3%			_		8	2		ğ	ING \$148.222
	- +	╺╌┠╴	-+-		2	2		IFREIGHT					_	25		CONSTRUCTION TIME SPAN: 300 CALENDIA DAYS	CALENDAR DAYS
	-ŀ-		01.67		320								-			PERCENT DIFFERENCE: 37%	
	5 i ∩	-	_		_		_	MORTAULY SPARES	28 E	EA 1.275.36		VALVES, REGUL, FILTERS, GAUGE	RLTERS.	GUIGE	35,710		COSTPER
		-	-	_	_		_	INITIAL SPARES	35 E	EA 937	937.11 VALV	VALVES. REGUL FILTERS GANGE	FLITERS	GANGE	32 700		1 001
	5 1 1 1	-+-	-	127	_	283					_						
	≦ -	-+			<u>ě</u>	_		IOIAL SYSTEMS	186 L	LF 959	959.33 959.33	33			178 474	ABPRCATTING	1,006.95 160,569
PRESSURE GAUGE	₹ -	-	0 35.67		214	4			-	+-						ASTROPAK	1,199.94 177.591
Q.D. SOCKET & CAP	-+	_			160			SEE SHEET 2 OF 2 FOR PICTURES OF PANELS AND MANIEDI DS ASSY	ES OF PAN	SLS AND A		Accv					
VISC. HARDWARE	74 EA	2.93	3 36.17		216							į	_				1,205.65 178,438
			ł		;	•								-	-		

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COMPUTER ANOL WHAT IF?			APPA
SSPF BID - GOVERNMENT JANUARY 8, 1991	ESTIMATE f	AGE 27	Jug
	=======================================		(11)
TAKS	AMOUNT	TOTALS	
ASK I	222222222222	================= !	
A. CIVIL	6,845,143	1	وسيد
B. ARCH/STRUCTURAL	26,192,370		
C. MECHANICAL	11,230,209		
D. ELECTRICAL	4,857,869		
E. CAFETERIA F. VVG	1,048,035 953,784	\$49,125,591	1
G. R&D	1,312,349	947/120/071	
H. R&PM	3,111,989		•
:	:		
	8	\$55,551,748	
SPECIAL CONDITIONS	0		1 1 1 1 1
ESCALATION	0		, , , , , , , , , , , , , , , , , , ,
	1 224 221	\$ 0	
AMENDMENT NO. 2	1,224,231		1 ' 1
		\$56,775,979	
-4% PROFIT MARKUP	(2,271,039)		1
-4% MATERIAL DISCOUNT	(2,271,039)		i i .
TOTAL TASK I	i i	\$52,233,901	1
TASK II (HVAC CONTROLS)	353,824		*
TASK III (PREMISES)	1,766,968	• 4 8	
TASK IV (SECURITY)	98,956	1	-
TASK V (ENVIRONMENTAL)	55,237	4 5 1	
TOTAL TASK II-V	1	\$2,274,985	1
	• • •	=====================================	Ì
TOTAL BID	4 •	\$54,508,886	;
TASK VI (NEW CHILLER)	1 1	\$1,735,898	i !
TASK VII (POWER FEEDER)		\$617,199	•
	1		1
TOTAL BID WITH OPTION		\$56,861,983	ł
	***************************************	;======================================	
	AMOUNT	SIES/CONT	
CofF		\$10,608,462	
R&D '		\$679,037	4
R&PM	\$3,111,989	\$653,518	1
	\$56,861,983		' •

	ARCHITEGT. ENGINEER	186	•		1 DCATION				
0000	ITECT. ENGINEE			PCN 76389	XSC	LC-39 (West of YAB)		Orbiter Processing Facility Phase	lase I
U.884U	Seelye, Steven	киенкек Stevenson, Yalue å Knecht. N.Υ.C.	(necht, N.Y.(C. (SSVK)		ESTIMATOR KAAS, SSVK/Pierce.	PRC	CHECKER GMC SSVK/Thomason DBC 100	Į
-			CONSTR	CTION C				DESCRIP	THING IN IO
DIV. TITLE 91Y UNIT	r sumr	S. BSF TOTAL	DIV. TOTAL	DIV. TITLE	3TT UNIT	S-UNIT S-BSF T	TOTAL DIV. TOTAL	DTAL SCOPE BASIC PLAN	
			11	9. FINISHES	52 ,800 SF	1.63 1.63	85,978	(Circle one) (Circle one)	COMMENTS
9 m		161,180	-	**** SYINY & Cera.	6 249 SF	1.54 .18	9.611		Commission Construct.
RK 40,0	40.59		1,626,570			.30	15,953	2002	77
_	1128.	.30 15,790		CEILING 3YS.	10,362 SF	4.42 .87 4	45.761	6	anes and Orb.
	31.19	.67 35,339		PAINT & COVER	32,466 SF	-27	14.047	5. SOPHISTICATED E. AC	cess Pitf.MIC
EATHWR. FILL/Seeding 40.070 CY	3.37	2.56 134,950		OTHER Rubber Str. Ird		10	606		
34,594	9.98	6.54 345.127			21 200 55]_	101	373 CLARKE AITUIANE HANGAR	
1 2 00°C	i I	1.89 39.205		Sprav-on Fire Proof.	ļ	1-	.373	STAUC, FRAME	
PANNG 28 7 100 15,417 5Y	48.02	14.02 740,468		11. EQUIPMENT	1_			Metal Siding W/	nsul, sconc. Blk.
		4.22 222,825						Ę	FT. 62 -FB
3. СОМСКЕТЕ 3,238 СҮ	139.60	8.56	452,039	12. FURMISMINGS	52.300 SF	14 .14	7.361	TOTAL FLOOR AREA 52,800	
32,		1.00 53,047		ssories	Various	. 14	7.361	VOLUME: 3,240,717	rs 52.93 CPC
228 TON	1082.	4.67 246,629		L COMSTR.				THE PERCENT AIR CONDITIONED: 100 % D	1 8 236' 4 084
3,198 CY	46.70	2.83 149.334		ELEV FLR. 5YS.				SPECIAL FEATURES C	200 59, 500, 146 7
	-			JTHER				BOC and Number Dy SSVK and modified by BOC and Number Dy	I modified by
onc. Slab	75.73	.06 3,029		14. CONVEYING SYS.				S. Tax 4%, O-Head 3%, Profit	52. Bond 12.
	2.79		88,086		643.8 TON	2672 32.58	1.720.272	272 Escalation 5%. A/C for AHU only, chillers	pnly, chillers
XIC 31,540	Z.78	1.66 87,622		Exterior Site Work	1,5.30 LF	175.64 5.99 *31	*316,147		
nd Beams	3.20	.01 464		Auto. Temp Control	1 575	72.724. 1.38 7	72,724	CONSTRUCTION BID DATA (IFB 10-00	0-6028-5
1,353	1208.	30.96	1,634,460	HVAC & Plumbing				11	
STRUC. STL 1,128 TON	1092.	23.321,231,253		for Fire Pump House	3, 4:)C SF	41.85 2.69 +14	*142,291	, 	3,254,728
~	-	1.68 88,523			4,033 LF	18.38 1.77 9	93, 189		633 072
	1149.	3.81 201.130		FIRE PROTECT HB & LB	6,629 LF	2.401	126,785	97	
Ξ	1.12	2.15 113,554		VENTILATING				TOTAL EXTERIOR: * \$ 48.33 BSF	· 2.552.003
stics 8,499	1.66	. 27	14,089	HEATSAC HB & LB	643.8 TON	1505. 18.35 96	968.336		36.675
000.	-1.71	.231 11,926		CLN. RM. HEAN				1 1	• 761.316
Y.MG. 1 499	=	.04 2,163		TICAL	2.534 KVA	418. 20.83	1.100.067	TOTAL PROJECT EST. 5 160	500,128
A MOISTURE PROTECT. 52,800 SF	9.61		507,635	ktures		88.		ACARDED TO	8,733,300
	0.43			S E	215,560 LF	0.33 1.36 7	71,546	CONSTRUCTION TIME SPAN: 600	CALENDAR DAYS
51,00	0.34			CONDUIT& Cable Tray		1.21	64,054	NO. OF BIODERS: I.C. POSITION OF GOVT. EST.	EST
(Theirlated) 55 000	19.0			EXTER SVCS. USDIe	39,653 LF	3.80 2.85 *15	*150,658		0 50 100
3/0.00	#0.C	5.801 JUD.410		SPCL. SYS. UNINTER PWG				GOV TA ESCINATE	821,000,62
0 & 20 GM.	2.19	- 1		ncs (ccs)	1 SYS	116,156 2.20 11	116,156	Continental Consol	000 220 0
5,899	5.40	.601 31,848		Sub Sta.	2,634 KVA	118.35 5.90 *31	*311,745	Tuttle White Con.Co.	9,095,000
4. DOORS & GLASS 37 EA	9830		363,707	Receptacles	225 EA	37.19 .16	8,368	J.A.Jones Con.Co.	9,169,000
	410.37	-23 12,311		Duct	İ	* 60.	4.592	Bav-Con General	9,159,000
SPECIAL DOORS & EA HOF 4,510 SF	74.50	6.36 335,997		Panel Boards	<u>1</u> 7,EA	30	15,639	McCloskey Co. Inc.	9.623.000
8	8.8	755.2 Icn.		X-FMR & Switch	6 EA		6.553	McManus,Longe,Brodkwells	9,690,000
	10 000			JTHER MISC.		_	304,062	i.	9,744,500
-	1798.71	.24' 12,362		PROJECT TOTALS		: 145.36	17,701,637	Morrison-Knudsen.I	10.592,000

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AUTHOR BIOGRAPHICAL DATA

Name: Joseph A. Brown

1

Position: Senior Advisor and Coordinator for Development of Cost Engineering and Estimating

Company: NASA/KSC, FL

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Paper Title: Estimating and Bidding for the Space Station Processing Facility

Professional Experience: Joseph A. Brown, CCE, has prepared and reviewed construction cost estimates amounting to over \$8 billion. He is a graduate of the University of Florida with a bachelor of building construction, BBC (1959). He has been a consultant to commercial, industrial and residential complex interests in several states including work for the Walt Disney World Contemporary Resort Hotel. He has received AACE's Fellow Award and the Charles V. Keane Distinguished Service Award, and the prestigious astronauts "Silver Snoopy," and the NASA Commendation Award for professional excellence and his contributions to the success of the manned space efforts. He has successfully prepared estimates for the U.S. Army Corps of Engineers and Air Force facilities. Mr. Brown has written an estimating workbook and is writing a text book, "Estimation of Construction Cost and Cost Engineering." He is currently employed by NASA at Kennedy Space Center, where he specializes in construction cost engineering as Senior Advisor and Coordinator for Development of Cost Engineering and Estimating.

Education: Bachelor of Building Construction, BBC, 1959, University of Florida

Professional Society Affiliations: AACE Member

Publications, Papers and Patents: 26 Technical Papers on Cost Engineering, etc.

Honors Received: AACE "Fellow", "Silver Snoopy", Charles V. Keane Distinguished Service Award, NASA Commendation Award

VISUAL AIDS REQUIREMENTS

____ None

X_ 35 mm Projector

- <u>X</u> Overhead Projector
- <u>X</u> Other (Specify): Movie Screen, Chalk Board or Flip Chart, Lapel Mike

