PROGRAMMING DOCUMENTS

ENERGY ENGINEERING ANALYSIS PROGRAM

WATER CONSERVATION AND LEAK DETECTION STUDY

FORT IRWIN, CALIFORNIA

PREPARED FOR

**DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA**

PREPARED BY

**KELLER & GANNON
1453 MISSION STREET, SAN FRANCISCO, CA 94103**

CONTRACT NO. DACA 05-C-92-0155

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

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Marie Wakefield,
Librarian Engineering

EEAP Water Conservation Study
Fort Irwin, California

Programming Documents
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1. COMPONENT Army	FY 1999 MILITARY CONSTRUCTION PROJECT DATA	2. DATE April 1997

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
National Training Center Fort Irwin, California	ECIP Install Additional Domestic Water Storage

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
	8000		883.0

9. COST ESTIMATES

Item	U/M	Quantity	Unit Cost	Cost ($000)
Primary Facilities: Additional water storage tank and piping:				674.8
Site Investigation	LS	--	--	(11.2)
750,000 Gallon Storage Tank including Site Work and Pad	LS	--	--	(342.9)
Underground piping, 12-inch	LF	6,400	48.45	(310.1)
Solar-Powered Telemetry System	LS	--	--	(10.6)
Supporting Facilities				0
Estimated Contract Cost				674.8
Contingency @ 10%				67.5
Subtotal				742.3
Supervision, Inspection and Overhead @ 5.5%				40.8
Design @ 6%				44.5
Unescalated CWE				827.6
Escalation to Midpoint of Construction: 1 June 1999				55.4
Total Request				883.0

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Install a new 750,000-gallon steel domestic water storage tank adjacent to the Ammunition Storage Area. Install about 6,400 feet of underground, concrete-lined, ductile iron, 12-inch diameter piping with corrosion resistant coating connecting the new tank to the existing 16-inch supply line from the Langford Basin wells. Provide a solar-powered radio telemetry system that transmits water level data to DPW Water System Control Building and a solar-powered impressed current cathodic protection system for the water tank. Underground water pipelines will be as specified in Corps of Engineers Guide Specification (CEGS) 02660, Water Lines, and the water storage tank will be as specified in GEGS 13206, Steel Standpipes and Ground Storage Reservoirs.

Verification of Savings: Cost savings will be estimated as the difference in overall electrical consumption (kWh) and demand (kW) charges for comparable periods before (baseline) and after installation of the new water tank and implementation of the well pump load shifting program. Allowance will be made for additional loads coming on-line after the baseline period. Verification that all well pumps are deenergized during peak electrical rate periods will be obtained from well pump status records available from the telemetry system.

DD FORM 1391

11. REQUIREMENT: N.A. **ADEQUATE**: N.A. **SUBSTANDARD**: N.A.

PROJECT: Install a new 750,000-gallon domestic water storage tank to allow curtailment of well pumping during peak electrical rate periods.

REQUIREMENT: By shifting well water pumping to off-peak rate periods, this project will save $114,986 annually in electricity demand and consumption charges. These savings result in a 7.24-year simple payback period and a savings-to-investment ratio of 2.08.

CURRENT SITUATION: Periods of peak water demand coincide with high electric rate periods, thus resulting in unit costs for electricity demand and consumption at the highest on-peak rates. Well pumps must be energized during periods of peak water demand since there presently is insufficient storage capacity to supply water requirements at Fort Irwin for the duration the 6-hour on-peak period.

IMPACT IF NOT PROVIDED: If this project is not accomplished, annual expenses of $114,986 for electricity demand and consumption will be incurred that could have been avoided.

ADDITIONAL: This project incorporates recommendations of the Energy Engineering Analysis Program, Water Conservation and Leak Detection Study, Fort Irwin, California, performed under Contract No. DACA05-92-C-0155.

This installation is not under consideration for realignment or closure.

[Name to be provided by installation.]
Commanding

Estimate Date: 1 April 1997	Index: 2063
Estimated Construction Start: 1 April 1999	Index: 2188
Estimated Midpoint of Construction: 1 June 1999	Index: 2201
Estimated Construction Completion: 1 August 1999	Index: 2214

DD FORM 1391C

Detailed Justification

1. GENERAL: Provision of additional domestic water storage will allow the shifting of well pumping from high electric power rate periods to low rate periods, thus significantly reducing Fort Irwin's annual expense for electric power.

2. ACCOMMODATIONS NOW IN USE: Not applicable.

3. ANALYSIS OF DEFICIENCY: The present requirement to operate well pumps during high electric power rate periods to meet demand for water results in unnecessary electric power expenses totaling $114,986 per year.

4. CONSIDERATION OF ALTERNATIVES: Since curtailing the supply of water during the peak electric power rate period (1200 to 1800 hours) will interfere with mission of Fort Irwin, providing additional water storage is the only viable alternative for shifting pumping to less costly rate periods. The project is recommended in the EEAP Water Conservation and Leak Detection Study, April 1997, prepared under Contract No. DACA05-C-92-0155.

5. CRITERIA FOR PROPOSED CONSTRUCTION: Design and construction will be in accordance with applicable criteria established in:
   a. DOD 4270.1-M
   b. TM 5-813-5, Water Supply and Water Distribution, 3 November 1986
   c. Architectural and Engineering Instructions, dated 3 July 1994
   d. A-E Guide, Volume 1 Instructions for Army Projects, dated January 1990
   e. A-E Guide, Volume 2, CESPK Cost Estimating Guide, dated December 1989
   f. A-E Guide, Volume 3, Specifications, dated December 1990
   g. TM 5-800-2, General Criteria, Preparation of Cost Estimates
   h. CEGS-02222, Excavation, Trenching and Backfilling for Utilities Systems
   i. GEGS-02660, Water Lines
   j. CEGS-02699, Valve Manholes and Piping and Equipment in Valve Manholes
   k. CEGS-13206, Steel Standpipes and Ground Storage Reservoirs
   l. CEGS-16642, Cathodic Protection System (Steel Water Tanks)

6. PROGRAM FOR RELATED FURNISHINGS AND EQUIPMENT: Not applicable.

7. DISPOSAL OF PRESENT ASSETS: Not applicable.

8. SURVIVAL MEASURES: Not applicable.

9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES: Temporary conditions will exist during the construction period consisting primarily offugitive dust emissions.

10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS: Not applicable.

11. ECONOMIC JUSTIFICATION: In accordance with ECIP Guidance dated 6 September 1996, an economic analysis has been prepared. Life-cycle cost analysis results are summarized as follows:

Estimated Construction Cost(including SIOH and Design)	$827,600
Annual Energy Savings	NA
First Year Energy Cost Savings	$114,986
First Year Non-Energy Cost Savings	($724)
Total First Year Cost Savings	$114,262
Discounted Energy Savings	$1,728,236
Discounted Non-Energy Savings	($10,382)
Total Net Discounted Savings	$1,717,854
Savings-to-Investment Ratio	2.08
Simple Payback Period (Years)	7.24

Refer to "Detailed Calculations" for backup data.

12. UTILITY AND TELECOMMUNICATIONS SUPPORT: Not applicable.

13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES: Review procedures have been implemented for this project by the installation in accordance with 36 CFR 800.

14. PROJECT DEVELOPMENT BROCHURE: A Project Development Brochure (PDB-1) will be prepared by the installation.

15. ENERGY REQUIREMENTS: Not applicable.

16. PROVISION FOR THE HANDICAPPED: Not applicable.

17. REAL PROPERTY MAINTENANCE ACTIVITY ANALYSIS: Not applicable.

18. COMMERCIAL ACTIVITES: This project involves modification of existing systems for energy cost savings. Under these conditions, the provisions of AR 5-XX do not apply, and a "new start or expansion" is not required.

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location:	Fort Irwin, California	Region No. 4	Project No.
Project Title:	ECIP Additional Domestic Water Storage		Fiscal Year FY99
Discrete Portion:	Total Project		Preparer: KELLER & GANNON
Analysis Date:	April 1997	Economic Life 20	Years

1. Investment Costs

A. Construction Costs		$742,300		
B. SIOH	5.5%	$40,827		
C. Design Cost	6.0%	$44,538		
D. Total Cost (1A+1B+1C)		$827,665		
E. Salvage Value of Existing Equipment			$0	
F. Public Utility Company Rebate			$0	
G. Total Investment (1D-1E-1F)				$827,665

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273-11 Used for Discount Factors: July 1996

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.		0	$18,524	15.03	$278,412
B. Dist				17.48	$0
C. Natural Gas				15.81	$0
D. Propane				15.81	
E. Demand Savings		787 kW	$96,462	15.03	$1,449,824
F. Total			$114,986		$1,728,236

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($724)		
(1) Discount Factor (Table A)		14.34	
(2) Discounted Savings/Cost (3A x 3A1)			($10,382)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.		0		$0
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4) ($10,382)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$114,262	
5. Simple Payback (1G/4):	7.24	Years
6. Total Net Discounted Savings (2F5+3C):	$1,717,854	
7. Savings to Investment Ratio (SIR) 5/1G:	2.08	

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Detailed Calculations

Introduction

The well pumps at Fort Irwin currently operate intermittently throughout the day to maintain adequate capacity in the one million gallon underground water storage tank and the three million gallon surface water storage tanks. Adding another storage tank and revising well pumping schedules to avoid the most costly on-peak period will lower both electricity usage and demand charges. Although overall electricity usage will not be decreased by shifting well pump operations to mid-peak and off-peak periods, the overall cost of energy for water pumping will be reduced since it will be consumed during lower-cost rate periods.

Technical Assumptions

1. Currently, there are 11 operating wells at Fort Irwin, of which one is dedicated to the Airfield and , thus, cannot be included in the load shifting savings. Total pumping during FY96 exceeded 1,057 million gallons, with peak summer month average consumption of 4.6 million gallons per day (mgd) and minimum winter month average consumption of 2.0 mgd.

2. Energy consumption for each SCE rate period was estimated as the product of total annual well kWh energy consumption and the fraction of total annual energy consumption for Fort Irwin consumed during that rate period based on SCE billings. Total annual energy consumed by the well pumps was calculated as the sum of the products of annual operating hours and measured input kWs to the well pump motors.

3. All well water pumping that now occurs between 1200 and 1800 hours is assumed to be shifted to the period between 2300 and 0800 the following morning. This shift will move all well pump summer consumption and demand from summer on-peak to summer off-peak periods and a portion of well pump winter consumption from winter mid-peak to winter off-peak periods. The consumption shifted is estimated as the fraction of mid-peak hours shifted to total daily mid-peak hours, or 6/13.

4. All of the well pumps are operating during some portion of the summer on-peak period; therefore, shifting operation to summer off-peak periods will reduce the summer on-peak demand charge for well pumping to zero. The reduction in demand charges during the 8 winter months is also estimated as the fraction of mid-peak hours shifted to total dialy mid-peak hours, or 6/13, with the kW shifted valued at the monthly maximum demand rate of $6.60 per kW.

5. A new water tank sized at 750,000 gallons will provide enough storage to eliminate well pump operations during the summer on-peak period from 1200 to 1800 hours. Proposed location of the new tank is adjacent to the Ammunition Storage Area, which will allow gravity feed to the Administration and Industrial Areas located at lower elevations.

6. The following table summarizes well pump operating data. Well pump power values were computed

from data collected during the field investigation or from data appearing on previous pump efficiency test reports. Pump operating hour data were provided by the Fort Irwin DEH Water Department.

Pump Designation	Input kW	Annual Operating Hours	Total Annual kWh Usage
B-1	69.1	3,349.8	231,471
B-4	57.1	2,976.2	169,941
B-5	82.9	5,927.3	491,375
B-6	72.3	4.2	304
L-1	79.8	3,115.5	248,617
L-2	70.5	1,997.0	140,789
L-3	83.7	965.7	80,829
I-3	68.1	3,114.0	212,063
I-5	65.2	3,769.8	245,791
I-7	138.1	1,963.6	271,173
	786.8		2,092,353

Current electric power rates applicable to Fort Irwin are summarized as follows:

kWh Consumption		
Summer On-Peak:	$	0.09422
Summer Mid-Peak:	$	0.05847
Summer Off-Peak:	$	0.03758
Winter Mid-Peak:	$	0.07071
Winter Off-Peak:	$	0.03874

kW Demand*		
Summer On-Peak:	$	17.95
Summer Mid-Peak:	$	2.70

* Plus a non-time-related charge of $6.60 per kW for maximum demand each month regardless of the time of occurrence.

LOCATION: Fort Irwin, California
PROJECT TITLE: ECIP Install Additional Domestic Water Storage

Date: April 1997

Electrical Consumption, Demand and Cost Savings

The following tables develop existing energy usage, demand and cost for the domestic system well pumps and projected future energy usage, demand and cost after the proposed load shifting:

Existing Consumption:			Existing Cost:	
Summer On-Peak =	194,589	kWh	$	18,334
Summer Mid-Peak =	267,821	kWh	$	15,659
Summer Off-Peak =	472,872	kWh	$	17,771
Winter Mid-Peak =	508,442	kWh	$	35,952
Winter Off-Peak =	648,629	kWh	$	25,128
	2,092,353	kWh	$	112,844

Existing Demand:			Existing Cost:	
Summer On-Peak =	787	kW	$	77,283
Summer Mid-Peak =	787	kW	$	8,500
Winter Mid-Peak =	787	kW	$	41,554
			$	127,337

Consumption After Load Shifting:			Future Cost:	
Summer On-Peak =	-	kWh	$	-
Summer Mid-Peak =	267,821	kWh	$	15,659
Summer Off-Peak =	667,461	kWh	$	25,083
Winter Mid-Peak =	273,776	kWh	$	19,359
Winter Off-Peak =	883,295	kWh	$	34,219
	2,092,353		$	94,320

Demand After Load Shifting:			Future Cost:	
Summer On-Peak =	-	kW	$	-
Summer Mid-Peak =	787	kW	$	8,500
Winter Mid-Peak =	424	kW	$	22,375
			$	30,875

Total Consumption Savings	$	18,524
Total Demand Savings	$	96,462
Overall Cost Savings	$	114,986

Additional Operations and Maintenance Costs

The new storage tank installation will require additional maintenance manhours to inspect and maintain the tank and associated piping and valves. Additional annual O&M costs are estimated as follows:

2 manhours/month x 12mos/year x $26.00/hour =	$	624
Misc. materials	$	100
Total Annual Additional O&M Costs	$	724

CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE	Date Prepared: Apr-97	Sheet: 1 of 2
Project: ECIP Additional Domestic Water Storage	Project No.	Basis for Estimate: Code A (no design competed)
Location: Fort Irwin, California		
Engineer-Architect: Keller & Gannon		
Drawing No.	Estimator: BIH	Checked By: RCL

Line Item	Quantity		Material		Labor		Equipment		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Per Unit	Total	
Site Investigation & Demolition									
Survey, Pipeline	6,400	LF	$0.03	$192	$0.54	$3,456	$0	$0	$3,648
Drawing, Boring Details	1	EA	$0	$0	$170.00	$170	$0	$0	$170
Auger Holes, 4-Ft Deep, every 100 LF	64	EA	$0	$0	$25.00	$1,600	$31.40	$2,010	$3,610
Field Stake-out, Elevations	1.00	EA	$0	$0	$390	$390	$0	$0	$390
Drawing showing Boring Details	1.00	EA	$0	$0	$170	$170	$0	$0	$170
Report & Recommendations from Engineer	1.00	EA	$0	$0	$375	$375	$0	$0	$375
Mobilization/Demobilization, minimum	1.00	EA	$0	$0	$123	$123	$154	$154	$277
Clearing - Hand	0.11	Acre	$0	$0	$1,350	$152	$505	$57	$209
Subtotal, Site Investigation & Demolition				**$0**		**$1,058**		**$154**	**$8,848**
Excavation / Backfill / Compaction (3-inch deep, 70-Ft x 70-Ft Area, 6% Grade)									
Excavate/Backfill by Hand	426	CY	$0	$0	$11.55	$4,920	$0	$0	$4,920
Compaction by Roller, Walking	426	CY	$0	$0	$2.95	$1,257	$0.86	$366	$1,623
Subtotal, Excavation / Backfill / Compaction				**$0**		**$6,177**		**$366**	**$6,543**
StorageTank Pad (Concrete)									
Forms in Place, Equip Foundation, 1 Use	157	SFCA	$2.27	$357	$7.60	$1,194	$0.26	$41	$1,591
Reinforcing Steel, in place	2.623	Ton	$510.00	$1,338	$395.00	$1,036	$0.00	$0	$2,374
Concrete In Place, nic Forms	145.4	CY	$63.50	$9,236	$21.50	$3,127	$0.37	$54	$12,417
Anchor Bolts, 3/4-inch Dia x 8-inch long	315	EA	$4.60	$1,449	$0.44	$139	$0.39	$123	$1,710
Subtotal, Tank Pad (Concrete)				**$12,379**		**$5,496**		**$218**	**$18,092**
Storage Tank and Appurtenances									
Storage Tank, 750,000 Gals, Steel, Ground Level	1	EA	$161,250	$161,250	$43,000	$43,000	$10,750	$10,750	$215,000
Impressed Current Cathodic Protection System, Solar Powered	1	EA	$12,000	$12,000	$3,000	$3,000	$0	$0	$15,000
Subtotal, Storage Tank and Appurtenances				**$161,250**		**$43,000**		**$10,750**	**$230,000**
Piping, Valves and Fittings									
Ductile Iron, Cement Lined, 12" Diameter	6,400	LF	$18.90	$120,960	$9.20	$58,880	$1.51	$9,664	$189,504
Corrosion Resistance Wrap & Coat	6,400	LF	$3.05	$19,520	$0	$0	$0	$0	$19,520
Ductile Iron Fittings, 12" Diameter	4	EA	$345.00	$1,380	$37.00	$148	$6.05	$24	$1,552
Butterfly Valves with Boxes, Cast Iron, 12" Diameter	2	EA	$1,250	$2,500	$221.00	$442	$36.00	$72	$3,014
Trenching, 40 HP, Riding, 16"Wx36"D	6,400	LF	$0	$0	$0.29	$1,856	$0.30	$0	$1,856
Backfill Trench, 1 CY Bucket Min. Haul	1,540	CY	$0	$0	$0.74	$1,140	$0.58	$0	$1,140
Pipe Bedding, Side Slope 1/2:1	6,400	LF	$1.01	$6,464	$1.39	$8,896	$2.40	$2	$15,362
Compaction by Vibr. Plate	6,400	LF	$0	$0	$0.37	$2,368	$0.29	$0	$2,368
Subtotal, Piping, Valves and Fittings				**$150,824**		**$71,362**		**$9,763**	**$231,948**
Telemetry System									
Tank Water Level Sensor	1	EA	$2,500	$2,500	$500.00	$500	$0	$0	$3,000
Telemetry Transmitter	1	EA	$3,000	$3,000	$800.00	$800	$0	$0	$3,800
Solar Module and Battery	1	EA	$800	$800	$300.00	$300	$0	$0	$1,100
Subtotal, Electrical Controls and Wiring				**$6,300**		**$1,600**		**$0**	**$7,900**
Subtotal				$330,753		$134,065		$22,284	$504,516

CONSTRUCTION COST ESTIMATE		Date Prepared Apr-97		Sheet 2 of 2	
Project ECIP Additional Domestic Water Storage		Project No.	Basis for Estimate Code A (no design competed)		
Location Fort Irwin, California					
Engineer-Architect Keller & Gannon					
Drawing No.	Estimator BIH		Checked By RCL		

Line Item	Quantity		Material		Labor		Equipment		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Per Unit	Total	
California Sales Tax	7.75%	%		$25,633				$1,727	$27,360
Subtotal									$531,877
Contractor OH & Profit	25.0%	%							$132,969
Subtotal									$664,846
Bond	1.5%	%							$9,973
Subtotal									$674,818
Estimating Contingency	10.0%	%							$67,482
Total Probable Construction Cost									**$742,300**

WORK REQUEST (IFS-M)

(For use of this form, see AR 420-17 and DA PAM 420-6; the proponent agency is USACE.)

PART A *(See Instructions)*	CUSTOMER ID CODE	DOCUMENT SERIAL NUMBER	FY	TYPE	SHORT JOB DESCRIPTION	DATE DA	DATE MON	DATE YR
	DPW		7	P	RECLAIM FLUSH & TEST WATER			

INSTALLATION ABBREVIATION OF FACILITIES	BUILDING / FACILITY NUMBERS 1	2	3	4	5	6	7	8	9	10
1 IRWIN										
2										
3										

REMARKS: **This Work Request is a result of the EEAP Water Conservation Study conducted by Keller & Gannon under Contract DACA05-C-92-0155. Economic analysis results are: $662 annual energy cost savings; $402 additional annual O&M cost; $2,091 investment; SIR = 2.00; payback period = 8.06 yr.**

INSTALLATION NAME:	CUSTOMER NAME	POC NAME	POC PHONE NUMBER
FORT IRWIN, CALIFORNIA	**Directorate of Public Works**	RENE QUINONES	619 380-5293

WORK DESCRIPTION (*Description of work requested*): **Refer to the attached information for details and specifics concerning the analyses.**

Fabricate six (6) custom pipe spools that will direct the flow from the flush hoses into the water truck top opening. Provide fittings on each pipe spool for attachment of a pressure gauge and pitot tube.

AUTHORIZED REQUESTOR (Type or Print) *SIGNATURE*

PART B *(Approving Official Only)*

APPROVAL ACTION CODE:
WORK REQUEST PRIORITY:
PROGRAM INDICATOR CODE:

SPECIAL INTEREST CODE:
ESTIMATED WORK START DATE: DATE DA MON YR
ESTIMATED WORK COMPLETION DATE:

ENVIRONMENTAL IMPACT

YES	NO	
☐	☐	ENVIRONMENTAL CONSIDERATION
☐	☐	EIS / EIA INITIATED
☐	☐	EIS / EIA COMPLETED

WORK TO BE PERFORMED
☐ IN-HOUSE
☐ SELF-HELP
☐ CONTRACT
☐ TROOP

WORKCLASS	APPROVAL AMOUNTS FUNDED	UNFUNDED
	$	$
	$	$
	$	$
TOTAL	$	$

SOURCE OF FUNDS
☐ DIRECT
☐ AUTOMATIC REIMBURSEMENT
☐ FUNDED REIMBURSEMENT

OTHER FUND CITATION

DESIGN APPROVAL	DATE DA	MON	YR	APPROVAL AUTHORITY	APPROVAL ACTION	DATE DA	MON	YR
(Please type or print name) *(Signature)*				*(Please type or print name)* *(Signature)*	☐ APPROVED ☐ DISAPPROVED			

WORK REQUEST: Reclaim Flush and Test Water
LOCATION: Fort Irwin, CA

Background

Fire hydrants are flowed annually in order to perform residual pressure tests. Additionally, a number of hydrants are allowed to flush in order to clear the lines of accumulated silt. According to water system operators, each flush is performed for a period of 20 minutes with at least a 2-1/2-inch diameter port opened to 100%. Measurements of fire hydrant residual pressures require no more than a few minutes of flow.

The residual pressure testing and system flush water are presently allowed to flow to the storm drainage system. There are some 309 fire hydrants serving Fort Irwin, of which only 10 are listed as out of service. Thus; water losses from these activities are significant.

Proposed Water & Energy Conservation Retrofit

It is proposed to collect domestic water distribution system flush water and water from fire hydrant residual pressure tests in water trucks for use in irrigation and/or for dust control. Water is presently dispensed from water trucks for these purposes, thus, the "saved" water represents a true savings.

Domestic water system flush water can be flowed through fire hoses directly into top loading manholes of water trucks. Sand and silt collected in the water truck tanks can be removed by using much less flushing water than is flowed from hydrants.

In order to collect fire hydrant residual pressure testing flow water, it will be necessary to modify the hydrant testing procedure to flow the hydrant into a water truck. This might best be accomplished by connecting a fire hose to the hydrant and directing the flow from the hose into the large opening on top of the water tank. Flow measurements could be taken at this location with a stream straightener directed into the water truck top opening. Alternately, a pitot tube could be fitted into a custom pipe spool attached to a top loading fitting on the water truck. A pressure gage could also be fitted onto the spool, allowing residual pressure and flow measurements to be accomplished more efficiently.

While NFPA 291, paragraph 2-5 and 2-6 discuss pitot tube flow velocity measurements directly from the fire hydrant 2-1/2-inch barrel butt, testing at hose ends, if of the same configuration as the hydrant butt should be valid. Alternately, the provisions of paragraph 2-9, Determination of Discharge Without a Pitot, should be considered. Use of this method requires installation of a pressure gauge on one of the non-flowing hydrant caps.

The proposed project will require:

1. Fabrication of six (6) custom pipe spools as described above. Six assemblies are provided to allow for residual pressure tests when multiple hydrants must be flowed.
2. Additional administrative time to plan logistics of requiring water trucks to be scheduled along with hydrant testing crews and to identify areas needing irrigation and/or for dust control.

WORK REQUEST: Reclaim Flush and Test Water
LOCATION: Fort Irwin, CA

Estimated Water Consumption from Annual Flushing from Hydrants

Water flushing for 20 minutes each per active hydrant is estimated:

Number of flushing hydrants:	50	Assumed points to clear piping of accumulated silt
Port Size Used for Flush:	2.5	inches diameter
Static Pressure in Supply Pipe:	60	psig, assumed average of 80 psig supply from P-140

(60 psig is used to allow for 20 psi drop during test and to provide a more conservative analysis.)

Flow Rate through Port:	834	gpm
Duration of Each Flushing:	20	minutes

Based on residual pressure of 20 psi (a very conservative value), the generally recommended minimum pressure for fire flow per NFPA 291, paragraph 2-1. Flow from NFPA 291, Table 2-10.1.

Annual total flush water: 834,000 gallons, or 16,680 gallons per flushing hydrant

From the previous sheet, each flushing is estimated to require 16,680 gallons of water.
Water trucks each hold about 4,000 gallons, thus, about 4 tank truck loads, with spillage

Estimated Water Consumption from Residual Pressure Testing of Hydrants

Water flushing for active hydrant is estimated:

Number of hydrants flowed:	299	Assumed points
Port Size Used for Flush:	2.5	inches diameter
Static Pressure in Supply Pipe:	60	psig, assumed average of 80 psig supply & T-140
Flow Rate through Port:	834	gpm
Duration of Each Flushing:	3	minutes

Based on residual pressure of 20 psi (a very conservative value), the generally recommended minimum pressure for fire flow per NFPA 291, paragraph 2-1. Flow from NFPA 291, Table 2-10.1.

Annual total flush water: 748,098 gallons, or 2,502 gallons per flowing hydrant

No more than a single water truck load is, thus, required per hydrant for residual pressure testing.

Total water usage from hydrant residual pressure testing and water system flushing:
1,582,098 gallons per year

Custom Pipe Spool Fabrication Costs

Each of six tools is assumed to cost $250 for fabrication in a custom plumbing shop
Total cost, with mark-up $1,875

WORK REQUEST: Reclaim Flush and Test Water
LOCATION: Fort Irwin, CA

Water Production O&M and Energy Cost Savings

From calculations of Domestic Water Costs:

Cost per 100 cubic feet = $0.4064 $0.5433 per 1000 Gallons

Component Costs:

Electric Demand:	$0.2398	/1000 gallons	
Electric Use:	$0.1783	/1000 gallons	
O&M:	$0.1252	/1000 gallons	(25% Allowance For Avoided Labor Costs)

Total Water Saved	1,582 thousand gallons/year			$860 per year saved, or	
Electric Demand Savings:	$379	/Yr Saved =	2.34 kW Saved @		$161.80 /kW-Year
Electric Use Savings:	$282	/Yr Saved =	5,232 kWH Saved @		$0.05393 /kWH
Water System O&M Savings:	$198	/Yr Saved			

Additional O&M and Administrative Costs

As stated in the previous sheet, extra efforts will be required to manage collection of the water system flushing and hydrant testing flows. Water system maintenance supervisors will have to arrange to have a water truck present when flushing. Fire fighters will have to coordinate in a similar fashion.

For system flushing, no added administrative costs are expensed as water trucks would be a normal component of the crew. Fire hydrant residual flow testing will require extra coordination as fire fighters and water system personnel will need to coordinate with each other.

The only extra costs are management costs to coordinate hydrant testing, irrigation and dust control logistics.

Assume, once a procedure is developed and used, that coordination time required per water truck load of 4,000 gallons is 5 minutes of a supervisory level person.

Hydrant Flowing:	206 loads per year		17 Hours/Year
Supervisory level personnel	$35 /Hour x	17 Hours/Year =	$600 per Year

Overall Non-Energy Savings

Water System O&M Savings	$198 per Year
Additional Management Costs	($600) per Year
Total Non-Energy Cost Savings	($402) per Year

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location:	Fort Irwin, California	Region No. 4	Project No.
Project Title:	Reclaim System Flush & Fire Hydrant Test Water		Fiscal Year FY96
Discrete Portion:	Total Project		Preparer: KELLER & GANNON
Analysis Date:	April 1997	Economic Life: 20	Years

1. Investment Costs

A. Construction Costs		$1,875		
B. SIOH	5.5%	$103		
C. Design Cost	6.0%	$113		
D. Total Cost (1A+1B+1C)		$2,091		
E. Salvage Value of Existing Equipment			$0	
F. Public Utility Company Rebate			$0	
G. Total Investment (1D-1E-1F)				$2,091

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273-11 Used for Discount Factors: July 1996

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$15.80	18		$282	15.03	$4,241
B. Dist					17.48	$0
C. Natural Gas					15.81	$0
D. Propane					15.81	$0
E. Demand Saving	$161.80	2.34	kW	$379	15.03	$5,702
F. Total				$662		$9,943

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($402)		
(1) Discount Factor (Table A)		14.34	
(2) Discounted Savings/Cost (3A x 3A1)			($5,765)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.		0		$0
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4) ($5,765)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$260	
5. Simple Payback (1G/4):	8.06	Years
6. Total Net Discounted Savings (2F5+3C):	$4,178	
7. Savings to Investment Ratio (SIR) 5/1G:	2.00	

WORK REQUEST (IFS-M)

(For use of this form, see AR 420-17 and DA PAM 420-6; the proponent agency is USACE.)

PART A (See Instructions)	CUSTOMER ID CODE	DOCUMENT SERIAL NUMBER	FY	TYPE	SHORT JOB DESCRIPTION	DATE DA	DATE MON	DATE YR
	DPW		7	P	ICE PLANT PRECOOLING RETROFIT			

INSTALLATION ABBREVIATION OF FACILITIES	BUILDING / FACILITY NUMBERS 1	2	3	4	5	6	7	8	9	10
1 IRWIN	887									
2										
3										

REMARKS: **This Work Request is a result of the EEAP Water Conservation Study conducted by Keller & Gannon under Contract DACA05-C-92-0155. Economic analysis results are: $7,988 annual energy cost savings; $2,712 add'l annual O&M cost; $30,371 investment; SIR = 2.67; payback period = 5.76 yr.**

INSTALLATION NAME:	CUSTOMER NAME	POC NAME	POC PHONE NUMBER
FORT IRWIN, CALIFORNIA	**Directorate of Public Works**	RENE QUINONES	619 380-5293

WORK DESCRIPTION (*Description of work requested*): **Refer to the attached information for details and specifics concerning the analyses.**

This project will collect wasted "snow" and wastewater flows to precool feed water to the ice plant as follows: (1) Install heat exchanger tank with heat exchange coils or stipple plate mounted inside the tank to collect "snow" and wastewater, (2) modify ice plant feed water piping, (3) modify wastewater collection piping, (4) install a solar-powered irrigation pump, (5) install concrete pads for the basin and transfer pump, and (6) provide provide irrigation piping and a new landscaped area adjacent to the ice plant.

AUTHORIZED REQUESTOR (*Type or Print*) ______ SIGNATURE ______

PART B (*Approving Official Only*)

APPROVAL ACTION CODE: ☐
WORK REQUEST PRIORITY: ☐☐☐
PROGRAM INDICATOR CODE: ☐☐

SPECIAL INTEREST CODE: ☐☐☐☐☐☐
ESTIMATED WORK START DATE: DA ___ MON ___ YR ___
ESTIMATED WORK COMPLETION DATE: DA ___ MON ___ YR ___

ENVIRONMENTAL IMPACT

YES	NO	
☐	☐	ENVIRONMENTAL CONSIDERATION
☐	☐	EIS / EIA INITIATED
☐	☐	EIS / EIA COMPLETED

WORK TO BE PERFORMED
- ☐ IN-HOUSE
- ☐ SELF-HELP
- ☐ CONTRACT
- ☐ TROOP

WORKCLASS	APPROVAL AMOUNTS FUNDED	UNFUNDED
☐	$	$
☐	$	$
☐	$	$
TOTAL	$	$

SOURCE OF FUNDS
- ☐ DIRECT
- ☐ AUTOMATIC REIMBURSEMENT
- ☐ FUNDED REIMBURSEMENT

OTHER FUND CITATION ☐☐☐☐☐☐☐☐☐☐☐☐

DESIGN APPROVAL

______ (*Please type or print name*)

______ (*Signature*)

DATE: DA ___ MON ___ YR ___

APPROVAL AUTHORITY

______ (*Please type or print name*)

______ (*Signature*)

APPROVAL ACTION
- ☐ APPROVED
- ☐ DISAPPROVED

DATE: DA ___ MON ___ YR ___

FORM 4283-1 (On Microsoft Excel Version 5.0)

F:\PROJ\1640321\ENGR\Form4283 Ice Plant

WORK REQUEST: Ice Plant Pre-Cooling Retrofit
LOCATION: Building 887, Fort Irwin, CA

Background

Ice is necessary to the mission at Fort Irwin because it (a) assists in lowering body temperatures of soldiers during periods of extreme heat and (b) makes the drinking water more palatable.
The ice plant at Fort Irwin has a rated capacity of 50 tons per day. The ice plant, Building No. 887, is located contiguous to Building No. 882, a cold storage warehouse. The ice making skid is situated on an elevated platform, some 29 feet high. Sheets of ice made by the ice machine are broken and conveyed into the building and transferred to the rake. Broken sheet ice is further broken and sized prior to being bagged. Bagged ice is stored on pallets for truck pickup.

During the summer, the highest demand period, the plant is capable of producing only about 30 tons per day (TPD). This reduced capacity is due, in part, to too high a feed water temperature. Other problems include frequent jamming of the equipment. The feed water rises up a 2-inch diameter PVC pipe, One inch of fiberglass insulation is installed with an aluminum jacket. Potable water is supplied at about 71°F, but is raised to about 88°F before is reaches to the ice plant.

The ice sizer installed up-line of the bagging operation rejects particles too fine to be bagged. The fines, or "snow" are discharged from the process from a shoot protruding from the building. This snow is allowed to melt, runoff and evaporate. Inspection of the ice plant operations revealed several discharges of cold water. The ice making plant functions by sending a stream of water over freezing plates. Sheet ice formed on the plates is released by briefly reversing the freezing process to heat up the plates. Water is circulated from a basin below the ice making sheets. The basin is purged or allowed to overflow depending on water quality. At Fort Irwin, a continuous overflow of about 3 gpm is needed. The screw conveyor used to transfer the broken sheet ice into the building and rake is upward inclined, allowing the wet ice to drain; this conveyor is also washed down between cycles.

Nameplate Data

Manufacturer:	Turbo Refrigerating Co., Denton, Texas (817) 387-4301		
Model:	TIGAR 50FL SCE	Dimensions:	118" x 94" x 110"
24Hr Capacity:	50 Tons Ice per day, nominal	Water Pump:	2 @ 1 HP, Each
Refrigeration:	75 Tons	Feedwater Flow:	8 gpm
Ammonia:	24 gpm	FLA:	14 Amps

Proposed Water & Energy Conservation Retrofit

The snow and wastewater flows from the ice plant represent a potential source for waste heat recovery. It is proposed to collect these waste streams and precool feed water to the ice plant. It is anticipated that this action will partially solve the ice plant capacity shortfall. Additionally, it is proposed to utilize the wasted wash water and melted "snow" for irrigating a landscaped area. This action will utilize otherwise wasted water and provide a landscaped area at the building. The proposed retrofit will consist of:

1. "Snow" and waste water collection / heat exchanger tank.
2. Heat exchange coils or stipple plate mounted inside the tank.
3. Ice plant feed water piping modifications.
4. Waste water collection piping modifications.
5. Solar powered irrigation pump.
6. Concrete pad for the basin and transfer pump.
7. Landscaping and irrigation piping.

Energy Required to Make Ice

50 Tons of Ice requires energy to lower the feed water temperature to 32°F from the rating standard 60°F, and energy for the phase change, with additional energy to sub cool the ice to 0°F. Energy needed to form 50 tons of ice at 0° from 60°F feed water is estimated based on the following:

	Ice, Heat of Fusion:	144 BTU/Lb
	Ice, Specific Heat:	0.465 BTU/Lb-°F @ -4°F
		0.468 BTU/Lb-°F @ -0°F, interpolated
		0.486 BTU/Lb-°F @ 25°F, interpolated
		0.487 BTU/Lb-°F @ 32°F
Heat to Lower feedwater to 32°F:		[50 tons x 2000 Lb/ton + 3 gpm x 60 min x 24 Hrs] x (60°F-32°F) =
at rated conditions		= 3,810,000 BTU (overflow of 3 gpm, continuous, see below)
Heat Needed for Fusion:		50 tons x 2000 Lb/ton x 144 BTU/Lb = 14,400,000 BTU
Heat Needed to Lower Ice to 0°F:		50 tons x 2000 Lb/ton x 0.468 (BTU/Lb-°F) x (32°F - 0°F) =
		= 1,530,000 BTU
Total Heat to make 50 Tons 0°F Ice:		19,740,000 BTU (values rounded for display)

In order to control water quality in the ice formed, the circulation basin under the ice forming plates of the ice machine is normally purged periodically. With the water quality at Fort Irwin, a continuous overflow of about 3 gpm is used to control water quality.

At a capacity of 50 Tons per 24-hour day, waste water from the ice maker is estimated at:
4,320 gpd. Assume the waste water exits the reservoir at 32°F

Wash water from the screw conveyor was observed to be on continuously during site inspections over a 10 day period. The flow is estimated at an additional 1.0 gpm. Assuming that the flow can be stopped when the ice plant is idle, daily water consumption is assumed cut in half for overflow and wash water flowed to drain. Reduced daily use is estimated at: 2,880 gpd. This water, although not at freezing temperature, is chilled by contact with the ice shoot. Assume this water is at 45°F as it leaves the ice shoot.

According to the ice machine manufacturer, "snow" from the sizer, comprise about 10% of overall production. The "snow" discharged from the sizing operation at Fort Irwin is assumed at 7.5% of overall ice production. Based on 50 tons per day production, daily "snow" discharge is estimated about at: 7,500 ppd. Although the ice plant is run for ice at 0°F, to be conservative, it is assumed that "snow" is at 25°F.

Summary: Energy from Waste Water and "Snow" at Full Capacity (24 Hr/Day Operations)

Ice Maker Overflow	4,320 gdp	32 °F Water	(current operations discharge
Shoot Wash Water	1,440 gdp	45 °F Water	these flows 100% of the time)
"Snow"	7,500 Lb/Day	25 °F Ice	

Standard ratings for the ice plant are based on an entering water temperature of 60°F. With a feedwater temperature of 88°F, the cooling energy needed to provide 60°F feed water, when making 50 tons of ice, and using the flow ratios above, is estimated at: 3,810,000 BTU

Thus, heat lost from too high a feed temperature will reduce the capacity of the ice plant by about: 19.3%
This may be part of the reason why the plant is referred to as a 40 TPD plant rather than a 50 TPD facility.

Potential Heat Recovery for Pre-Cooling Feed Water (Ice Plant at Full Capacity)

The flows of waste water and ice are combined; the 45°F water will warm the ice slightly	
Assuming all the water is cooled to 32°F, the wash water cooling energy need is:	156,300 BTU/Day
The energy required to warm the ice from 25°F to 32°F is:	25,500 BTU/Day
Remaining Energy after Warming Ice to 32°F:	130,800 BTU/Day

This energy is available to melt the ice. At a heat of vaporization of 144 BTU/Lb,
the "Snow" melt energy required for 32°F is: 1,080,000 BTU/Day
Thus, 12% of the ice is melted, the remainder will stay ice until makeup water is cooled by the mixture.

The revised mixture consists of:

Water at 32°F:	5,869 gpd 32°F Water	
Ice at 32°F:	6,592 Lb/Day Ice, heat needed to melt it is:	949,200 BTU/Day

Feed water enters at 71°F; 17,736 gpd are fed to the Ice Plant
The feedwater temperature is lowered to: 64.6°F by melting the ice.

Now there are	17,736 gpd of feed water at	64.6°F	to be cooled by
	6,658 gpd of waste water at	32.0°F	available to cool the feed water

Precooling the feed water with this mixture, assuming a 5°F approach, feed water is cooled to: 60.7°F
before it enters the riser to the ice plant, almost the design temperature!

Heat gain for flow from the heat exchanger-basin, up the pipe, to the ice making machine, is estimated:
Piping is 2-inch diameter PVC with 2-inch fiberglass insulation and reflective aluminum jacket.

Design Summer Temperature (TM 5-785):	106°F	
Summer Cooling Degree-Days:	2,272	
Design Winter Temperature (TM 5-785):	26°F	Winter time heat gain is negligible
Winter Heating Degree-Days:	2,547	and is, thus, neglected

Insulation convective heat gain per 68°F air temperature and 45°F water: 28 BTUH/10 LF Pipe
(A/E Guide to Energy Conservation in Existing Buildings, Feb 1, 1980, US DOE, Figure 8-49)
Summer design temperature heat loss:

Figure 8-49 Temp. Difference:	45.0°F	water	68°F	air =	23°F
Actual Temperature Difference:	60.7°F	water	106°F	air =	45°F
Heat Gain Adjustment Factor:	45°F	÷	23°F	=	1.97
Adjusted Design Summer Heat Gain:					55.2 BTUH/10 LF Pipe
Summer Total Heat Gain:	15,823 BTU/10 LF Pipe per Year				
Preliminary takeoff of exposed piping:	86 LF;		136,074 BTU/Year Heat Gain		

At 50 tons per day, and allowing for the ice maker basin waste, average flow is:	12.32 gpm
Temperature rise from the heat gain at design conditions:	0.1°F
Thus, the feed water entering the ice plant will be at about:	60.8°F

Although not at the rated temperature of 60°F, a considerable amount of overall energy savings is achieved.

Energy savings at the rated capacity of the ice maker is estimated: Energy difference between
88.0°F and 60.8°F feed water at 50 tons per day capacity is: 154,373 BTUH
This comprises 12.9 Refrigeration Tons of increased capacity.
At a COP of 3.52 this represents a 12.8 kW savings when the plant operates at 100%.

Annual Electrical Consumption and Cost Savings:

Recorded Ice Issues and purchases

Month	Tons Issued	Planned Production	Tons Purchased
Sep-95	771	600	171
Oct-95	309	246	63
Nov-95	124	124	0
Dec-95	63	0	63
Jan-96	77	77	0
Feb-96	105	105	0
Mar-96	123	123	0
Apr-96	251	250	1
May-96	481	391	90
Jun-96	447	250	197
Jul-96	1,186	715	471
Aug-96	1,036	850	186
12 Month Totals	4,973	3,731	1,242

250 days per year, assumed; weekday operations
14.9 TPD average production rate (calculated)
3,731 Tons per Year Produced

3,705,000 BTU/50 Tons Ice Cooling Energy Saved
23,550,000 BTU/50 Tons Ice Cooling Energy Used Presently

276,467,000	BTU Electric Power Saved =	81,004 kWH/Year Saved
		$0.07295 /kWH-Yr Weekdays
	Based on Week Day Power Rates	$5,909 per Year Usage Costs Saved
	Demand Saved at Same Production Rate	12.8 k W
		$161.80 /kW-Yr Weekdays
		$2,079 per Year Demand Costs Saved

Power Costs for Operating the Ice Plant:

Turbo, the manufacturer states that the COP of the ice plant is: 3.52

The plant is operated normally from 0800 to 1630 on week days.

Monthly Demand Charges per kW

	Summer On-Peak	Summer Mid-Peak	Summer Off-Peak	Winter Mid-Peak	Winter Off-Peak
Total Base Rate	$17.95	$2.70	$0.00	$0.00	$0.00
Non Time-Rltd	$6.60	$0.00	$0.00	$6.60	$0.00
Total Demand	**$24.55**	**$2.70**	**$0.00**	**$6.60**	**$0.00**

Note that demand charges are assessed for the whole month in each period with demand.

Electricity Consumption Rates ($/kWH)

Total Base Rate	0.09422	0.05847	0.03758	0.07071	0.03874

Operating Scenario, Weekdays

Summer 87 d/y	1200-1800	0800-1200	0000-0800	0800-2100	0000-0800	
Winter 173 d/y		1800-2300	2300-0000		2100-0000	
Present Operations, Weekdays Only						
Op Hrs/Day	4.5	4	0	8.5	0	**Annual Average**
Annual ($/kWH)	$36.89	$20.35	$0.00	$103.98	$0.00	**$0.07295 per kWH**
Continuous Operations, Weekdays Only						
Hr/D in Period	6	9	9	13	11	**Annual Average**
Annual ($/kWH)	$49.18	$45.78	$29.43	$159.03	$73.72	**$0.05723 per kWH**
Annual ($/kW)	$98.20	$10.80	$0.00	$52.80	$0.00	**$161.80 per kW**

Operation & Maintenance Costs for Precooling System

Operation and maintenance on the precooling system is expected to require no more than 6 man-days per year, or about: $1,356 per year labor; assume a similar investment in materials costs, for total annual O&M costs of: $2,712 per year.

WORK REQUEST: Ice Plant Pre-Cooling Retrofit]
LOCATION: Building 887, Fort Irwin, CA

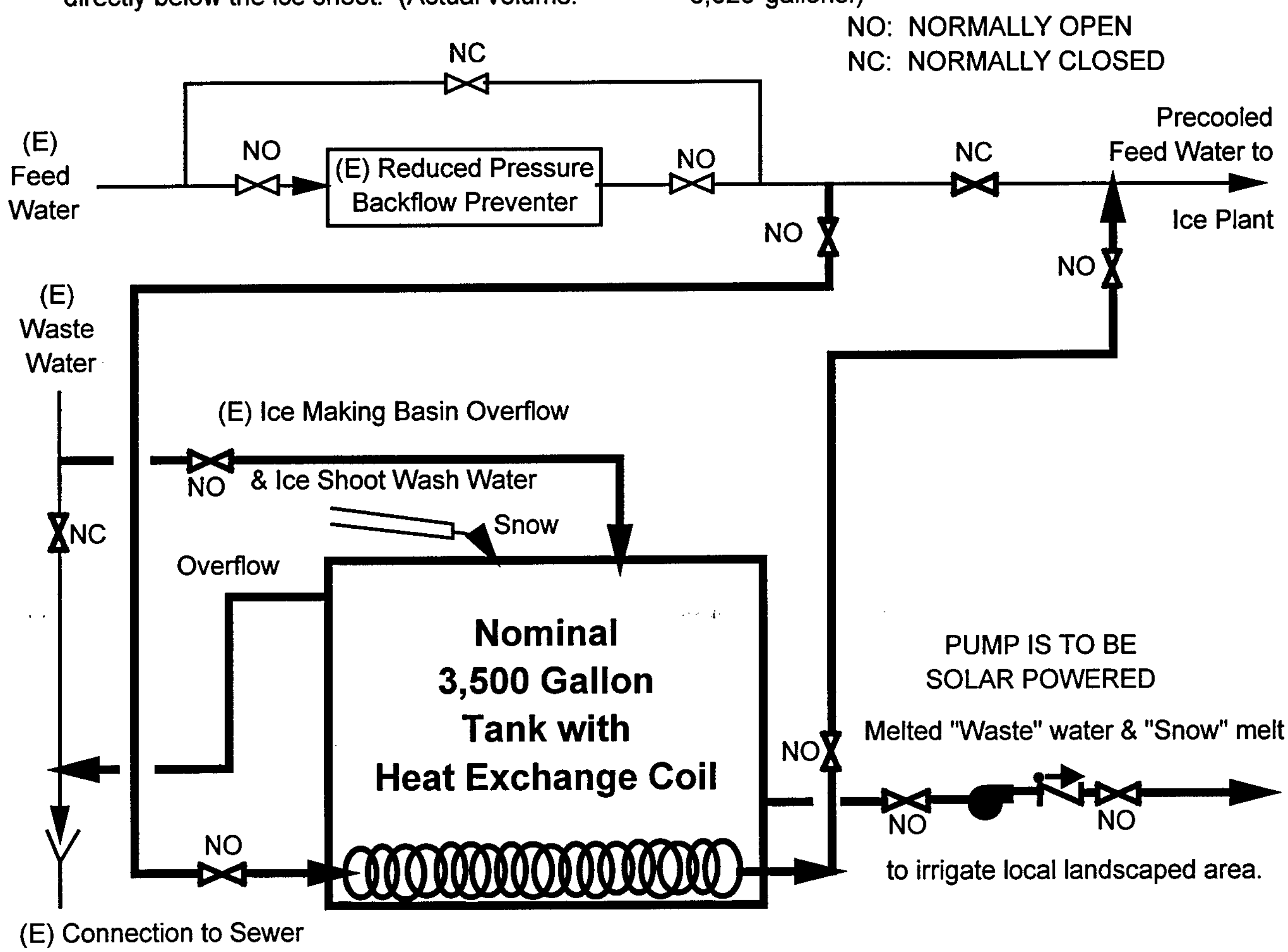
Concept Design of Heat Exchange Basin

Ice Plant Basin Overflow	4,320 gdp	32 °F Water
Ice Shoot Wash Water	1,440 gdp	45 °F Water
"Snow"	7,500 Lb/Day	25 °F Ice

The process consists of batch processing to produce ice and a continuous bagging operation. Water will be pumped out (or allowed to flow out) of the basin during the daylight hours, assisted by a solar powered pump. Thus, the plant must be designed to hold waste ice and water of at least 1/2 day's production.

Assuming the "Snow" has melted, the volume required is: 3,329 gallons

Space available will fit a 10-foot diameter tank with room for a footer between the ice machine supports and a condenser pad; tank height is: 5.67 feet high, install one 6-feet high. Place it directly below the ice shoot. (Actual volume: 3,525 gallons.)



CONSTRUCTION COST ESTIMATE	Date Prepared: Apr-97	Sheet 7 of 8
Project: Ice Plant Feed Water Precooling Retrofit	Project No.	Basis for Estimate: Code A (no design competed)
Location: Fort Irwin, California		
Engineer-Architect: Keller & Gannon		
Drawing No.	Estimator: BIH	Checked By: RCL

Line Item	Quantity No. Units	Quantity Unit Meas.	Material Per Unit	Material Total	Labor Per Unit	Labor Total	Equipment Per Unit	Equipment Total	Total Cost
Site Investigation & Demolition									
Field Stake-out, Elevations	1.00	EA	$0	$0	$390	$390	$0	$0	$390
Drawing showing Boring Details	1.00	EA	$0	$0	$170	$170	$0	$0	$170
Report & Recommendations from Engineer	1.00	EA	$0	$0	$375	$375	$0	$0	$375
Mobilization/Demobilization, minimum	1.00	EA	$0	$0	$123	$123	$154	$154	$277
Clearing - Hand	0.06	Acre	$0	$0	$1,350	$77	$505	$29	$106
Subtotal, Site Investigation & Demolition				**$0**		**$1,058**		**$154**	**$1,212**
Excavation / Backfill / Compaction (3-inch deep, 50-Ft x 50-Ft Area)									
Excavate/Backfill by Hand	23.15	CY	$0	$0	$11.55	$267	$0	$0	$267
Compaction by Roller, Walking	23.15	CY	$0	$0	$2.95	$68	$0.86	$20	$83
Subtotal, Excavation / Backfill / Compaction				**$0**		**$336**		**$20**	**$356**
Tank Pad (Concrete)									
Forms in Place, Equip Foundation, 1 Use	21	SFCA	$2.27	$48	$7.60	$162	$0.26	$6	$216
Reinforcing Steel, in place	0.032	Ton	$0.16	$0	$0.22	$0	$0.00	$0	$0
Concrete In Place, nic Forms	1.8	CY	$63.50	$112	$21.50	$38	$0.37	$1	$150
Anchor Bolts, 3/4-inch Dia x 8-inch long	35	EA	$4.60	$159	$0.44	$15	$0.39	$13	$188
Subtotal, Tank Pad (Concrete)				**$319**		**$215**		**$20**	**$553**
Storage Tank and Appurtenances									
Storage Tank 3,500 gallons, interpolated	1	EA	$3,050	$3,050	$250	$250	$0.00	$0	$3,300
Cooling Coil, Tank Type	1	EA	$1,100	$1,100	$64	$64	$0.00	$0	$1,164
Special Construction for "Snow: Shoot	1	EA	$250	$250	$500	$500	Included		$750
Subtotal, Storage Tank and Appurtenances				**$4,400**		**$814**		**$0**	**$5,214**
Pump, Piping and Fittings									
PVC Pipe, Schedule 40, 2-inch	120	LF	$2.62	$314	$7.50	$900	$0.00	$0	$1,214
PVC Pipe Elbow, 2-inch	36	EA	$33.00	$1,188	$19.20	$691	$0.00	$0	$1,879
CPVC Ball Valve, Socket or Threaded, 2"	10	EA	$89.50	$895	$14.45	$145	$0.00	$0	$1,040
Ball Check, PVC, Socket or Threaded, 2"	1	EA	$82.00	$82	$14.45	$14	$0.00	$0	$96
Insulation, 2-inch Fiberglass w/ All Srvc Jkt	261	LF	$3.21	$838	$2.32	$606	$0.00	$0	$1,443
0.010-inch Aluminum Jacket, Tank & Piping	779	SF	$0.44	$343	$2.08	$1,619	$0.00	$0	$1,962
Irrigation Pump, 5 GPM, Say 1/40 HP	1	EA	$104.00	$104	$27.50	$28	$0.00	$0	$132
PVC Pipe, Schedule 40, 1/2-inch, incl. fittings	200	LF	$1.59	$318	$4.55	$910	$0.00	$0	$1,228
Irrigation Fittings, Allowance	1	LS	$250.00	$250	$500.00	$500	$0.00	$0	$750
Trenching with Chain Trencher, 4"Wx12"D	200	LF	$0.26	$52	$0.11	$22	$0.37	$74	$148
Subtotal, Pump, Piping and Fittings				**$4,384**		**$5,435**		**$74**	**$9,892**
Electrical Controls and Wiring									
High and Low Level Pump Control	1	EA	$500	$500	$250	$250	$0	$0	$750
Time Clock	1	EA	$118.00	$118	$67	$67	$0	$0	$185
Photvoltaic Array and Inverter, 25W	1	EA	$300	$300	$75.00	$75	$0	$0	$375
Disconnect Switch	1	EA	$49.50	$50	$75.00	$75	$0	$0	$125
Subtotal, Electrical Controls and Wiring				**$968**		**$467**		**$0**	**$1,435**
Subtotal				$10,070		$8,362		$282	$18,715
California Sales Tax	7.75%	%		$780				$22	$802
Subtotal									$19,517
Contractor OH & Profit	25.0%	%							$4,879
Subtotal									$24,396
Bond	1.5%	%							$366
Subtotal									$24,762
Estimating Contingency	10.0%	%							$2,476
Total Probable Construction Cost									$27,238

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Fort Irwin, California   Region No. 4   Project No.
Project Title: Ice Plant Feed Water Pre-Cooling Retrofit   Fiscal Year FY96
Discrete Portion: Total Project   Preparer: KELLER & GANNON
Analysis Date: April, 1997   Economic Life: 20 Years

ANALYSIS BASED ON CURRENT PRODUCTION RATES

1. Investment Costs

A. Construction Costs		$27,238		
B. SIOH	5.5%	$1,498		
C. Design Cost	6.0%	$1,634		
D. Total Cost (1A+1B+1C)		$30,371		
E. Salvage Value of Existing Equipment			$0	
F. Public Utility Company Rebate			$0	
G. Total Investment (1D-1E-1F)				$30,371

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273-11 Used for Discount Factors: July 1996

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.37	276	$5,909	15.03	$88,813
B. Dist				17.48	$0
C. Natural Gas				15.81	$0
D. Propane				15.81	$0
E. Demand Saving	$161.80	12.8 kW	$2,079	15.03	$31,248
F. Total			$7,988		$120,061

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($2,712)		
(1) Discount Factor (Table A)		14.34	
(2) Discounted Savings/Cost (3A x 3A1)			($38,890)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.		0		$0
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)   ($38,890)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$5,276	
5. Simple Payback (1G/4):	5.76	Years
6. Total Net Discounted Savings (2F5+3C):	$81,171	
7. Savings to Investment Ratio (SIR) 5/1G:	2.67	