

CONSTRUCTION SPECIFICATIONS

FOR

SQUAW PEAK WATER TREATMENT PLANT BYPASS LINE

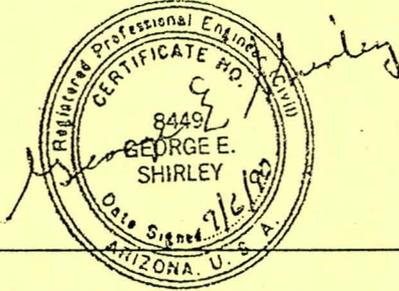
FCD CONTRACT NO. 90-31

CONSTRUCTION SPECIAL PROVISIONS

Prepared By:

JOHN CAROLLO ENGINEERS, INC.
3877 North 7th Street, Suite 400
Phoenix, Arizona 85014-5005

Flood
Property of
District of MC Library
Return to
N. Durango
AZ 85009



(Engineer's Seal)

Prepared For:

Flood Control District of Maricopa County
and

Recommended By: Nick Karan Date: 9-5-90
Nicholas P. Karan, P.E., Chief
Engineering Division

Approved By: D. E. Sagramoso Date: 9-7-90
D.E. Sagramoso, P.E.
Chief Engineer and General Manager

SUPPLEMENTARY TO MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION EDITION OF 1979 AND REVISIONS AND SUPPLEMENTS THERETO.

ADDENDUM NO. 1

DATE: September 18, 1990

FCD CONTRACT NO. 90-31

PAGE 1 OF 1

To Contract Documents

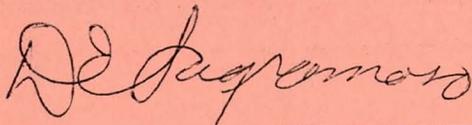
ENTITLED: SQUAW PEAK WATER TREATMENT PLANT BYPASS LINE

OWNER: Flood Control District of Maricopa County

The above documents are herein modified. The provisions of said documents applicable to these modifications remain unchanged unless specifically indicated otherwise herein. This addendum forms a part of the contract documents and modifies them as follows:

TO INVITATION TO BID AND BIDDING SCHEDULE:

1. On page 3 of 23 of the Invitation to Bid, Principle Items and Approximate Quantities, change 244,000 EA Reinforcing Steel TO 244,000 LBS Reinforcing Steel.
2. To the Bidding Schedule, remove page 6 of 23 and replace with page 6r of 23.



D.E. Sagramoso, P.E.
Chief Engineer and General Manager
Flood Control District of Maricopa County

BIDDING SCHEDULE

PROJECT: Squaw Peak Water Treatment Plant

CONTRACT: FCD 90-31

ITEM NO.	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT COST (IN WRITING) AND /100 DOLLARS	UNIT COST (NUMBERS)	EXTENDED AMOUNT
206-1	Structural Excavation and Backfill	1	LS			
211-1	Fill Construction	1	LS			
505-1	Structural Concrete	1,348	CY			
505-2	Demolition and Removals at Existing Pump Station No. 2 Forebay	1	LS			
505-3	Reinforcing Steel	244,000	LBS			
515-1	Miscellaneous Steel	1	LS			
520-1	Miscellaneous Aluminum	1	LS			
1500-1	96" R.G.R.C.P. Class II, with Fittings and Bulkhead	70	LF			
1500-2	Relocate Existing 4" PVC Waterline, 6" and 8" Sludge Lines	1	LS			
1500-3	Connection of 96" R.G.R.C.P. at Existing Junction Structure	1	LS			
1600-1	Relocate Existing Electric	1	LS			
1600-2	Concrete Duct Bank	380	LF			
1600-3	Electrical Manholes/Pull Boxes	6	EA			

TOTAL BID AMOUNT: _____

Minutes of Pre-Bid Meeting
FCD Contract No. 90-31
Squaw Peak Water Treatment Plant Bypass Line

September 17, 1990
1 pm at the Flood Control District

An attendance roster is attached. A representative from only one contractor attended the meeting. The only question discussed was a discrepancy between the principle items listed in the Invitation to Bid and the Bidding Schedule. In response to that, an addendum will be issued. The addendum adds two items to the Bidding Schedule to make it consistent with the Construction Special Provisions. The items added are Structural Excavation and Backfill and Reinforcing Steel.

FCD 90-31
SQUAW PEAK WATER TREATMENT PLANT BYPASS LINE
BID OPENING: SEPTEMBER 25, 1990 AT 2:00 P.M.
COST: \$12.00

- | | | | |
|----|---|--------|---------|
| 1. | Mingus Constructors, Inc.
P. O. Box 1999
Cottonwood, AZ 86326
634-9556 - Ken Miller
634-0206 FAX | 5 | \$12.00 |
| 2. | Western Sun Contractors
P. O. Box 32866
Phoenix, AZ 85064
.957-2119
470-1012 FAX
Phil Carosello | 6 | \$12.00 |
| 3. | Tiffany Construction Co.
1850 W. Broadway, Suite 112
Phoenix, AZ 85041
276-2414
268-5180 FAX
Linda Hopkins | 7 | \$12.00 |
| 4. | Lundell Construction Co., Inc.
6100 S. Maple. Suite 114
Tempe, AZ 85283
831-9179 - Robert Stephany | 8 | \$12.00 |
| 5. | New Construction, Inc.
1992 E. First St.
Tempe, AZ 85281
968-7801 - Lowell New
921-7304 - FAX | 9 | \$12.00 |
| 6. | F. W. Dodge
1715 W. Northern, #102
Phoenix, AZ 85021 | 10, 11 | N/C |
| 7. | Hunter Contracting Co.
701 N. Cooper Road
P. O. Box 900
Gilbert, AZ 85234
892-0521 - Tom Sornsin
892- 4932 - FAX | 12 | \$12.00 |
| 8. | Gilbert Pump & Equipment
1475 E. Elwood
Phoenix, AZ 85036
276-5599 - Larry Gilbert
(800) 558-5203 - FAX | 13 | \$12.00 |

9.	BRW Surveyors 2700 North Central #1000 Phoenix, Arizona 85004 234-15991 - Ed Vincent 230-9189 - FAX	14	\$12.00
10.	D.E. Johnson Electric, Inc. P. O. Box 24192 Tempe, AZ 85285-4192 345-1294 - Jim Goergen 820-5532 FAX	15	\$12.00
11.	Dunn Del Re Steel 353 S. Washington Street Chandler, AZ 85225 963-1424 - Judy Alexander 786-1238 FAX	16	\$12.00
12.	Ames Construction, Inc. 1801 S. 51st Avenue Phoenix, AZ 85043 995-0622 - Basil 995-8137 - FAX	17	\$12.00
13.	Ameron 2325 S. 7th Street Phoenix, Arizona 85036 252-7111 - Thomas Domizi 258-8456 - FAX	18	12.00
14.	Hard Rock Construction, Inc. 1910 W. Deer Valley Road, 2-353 Phoenix, AZ 85027 492-0518 - Buzz 780-9795 - FAX	19	12.00
15.	Hugh Coplen & Associates. 3201 West Thomas Road Phoenix, Arizona 85017 278-5629 - Hugh Coplen 269-3932 - Fax		12.00
16.	Reppel Steel, Inc. 3119 East Madison Street Phoenix, Arizona 85034 273-1661 - Bill Lucas 273-1665 - FAX		12.00

CONSTRUCTION SPECIFICATIONS

FOR

SQUAW PEAK WATER TREATMENT PLANT BYPASS LINE

FCD CONTRACT NO. 90-31

CONSTRUCTION SPECIAL PROVISIONS

Prepared By:

JOHN CAROLLO ENGINEERS, INC.
3877 North 7th Street, Suite 400
Phoenix, Arizona 85014-5005



(Engineer's
Seal)

Prepared For:

Flood Control District of Maricopa County
and

Recommended By: Nick Karan Date: 9-5-90

Nicholas P. Karan, P.E., Chief
Engineering Division

Approved By: D. E. Sagramoso Date: 9-7-90

D.E. Sagramoso, P.E.
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SUPPLEMENTARY TO MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD
SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION EDITION OF 1979 AND
REVISIONS AND SUPPLEMENTS THERETO.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FCD CONTRACT 90-31

SQUAW PEAK WATER TREATMENT PLANT BYPASS LINE

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17. Drawings: Squaw Peak Water Treatment Plant Bypass Line, 9 plan sheets	Separate



(Area to left reserved for Engineer's Seal)

ATTENTION
ALL PROSPECTIVE BIDDERS

Some of the Bid Bonds previously received with bids for construction projects have not been in complete compliance with Arizona Revised Statutes (A.R.S.).

A.R.S. Sec. 34-201(A)(3) requires that every bid be accompanied by a certified check, cashier's check or surety bond for five percent (5%) of the amount of the bid.

In some cases the bond limit the five percent (5%) to the difference between the low bid and that of the next lowest responsible bidder, to whom a contract could be awarded, in the event that the low bidder failed to enter into contract within the specified time.

Bids received with limitation on the five percent (5%) will be considered as nonresponsive bids and will not be accepted or considered for award of contract.

Please take note and submit your bids accordingly.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
INVITATION TO BID

BID OPENING DATE: September 25, 1990

LOCATION:

This project is located at the Squaw Peak Water Treatment Plant (WTP), 2202 East Maryland Avenue, Phoenix, Arizona.

PROPOSED WORK:

The work consists of construction of a bypass line around the existing presedimentation basin, relocation of an electrical duct bank, and other miscellaneous items of work required for the completion of the project.

BIDS:

SEALED BIDS for the proposed work will be received by the Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona 85009 until 2:00 p.m. (Phoenix time) on the above date and then publicly opened and read at 3335 W. Durango St., Phoenix, AZ 85009. No bids will be received after the time specified for bid opening. All bids must be submitted on proposal forms furnished by the Flood Control District and included in the Proposal Pamphlet. The Board of Directors reserves the right to reject any and all bids and to waive any informality in any bid received.

ELIGIBILITY OF CONTRACTOR:

It is the policy of Flood Control District of Maricopa County to endeavor to ensure in every way possible that minority and women-owned business enterprises have every opportunity to participate in providing professional services, purchased goods, and contractual services without being discriminated against on the grounds of race, religion, sex, age, or national origin.

The bidder shall be required to certify that it is appropriately licensed as a Contractor in the State of Arizona for performing the before-mentioned type of work. Verification shall be on the form provided herein.

The bidder may be required to furnish an affidavit as evidence of previous satisfactory performance in the above-mentioned type of work.

CONTRACT TIME:

All work on this Contract is to be completed within one hundred eighty (180) calendar days after date of Notice to Proceed.

MBE/WBE PARTICIPATION:

For this project, a goal of ten (10) percent is desired for Minority/Women-Owned Business Enterprises. Instructions and required forms are included in the Minority and Women-Owned Business Enterprise Program Section.

PRE-BID CONFERENCE:

A pre-bid conference will be held on September 17, 1990 at 1:00 p.m. in the Flood Control District conference room, 3335 West Durango Street, Phoenix, Arizona 85009. It is in the best interest of prospective bidders to attend the Pre-bid Conference.

Questions or items for clarification may be addressed to the Chief, Contracts Branch, in writing, at least ten (10) days prior to bid opening date. Where appropriate, any answers or clarifications affecting the cost may be addressed to all bidders in an addendum. Under no circumstances will verbal interpretations or clarifications be given to individual contractors.

PROJECT PLANS, SPECIAL PROVISIONS AND CONTRACT DOCUMENTS:

Plans and Construction Specifications may be obtained from Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona 85009 upon payment of \$12.00 by check, payable to the FLOOD CONTROL DISTRICT of MARICOPA COUNTY. This payment will not be refunded. Mail orders for project documents must include an additional \$7.50 for first class U.S. postage and handling. The total \$19.50 will not be refunded. Regardless of circumstances, we cannot guarantee mail delivery. Each bid must be accompanied by a Bid Bond, cashier's or certified check or postal money Order equal to 5 percent (5%) of the bid, made payable to the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY as a guarantee that if the work is awarded to the bidder, the bidder will within ten (10) days of receipt of the Proposal Acceptance, enter into proper contract and bond condition for the faithful performance of the work, otherwise, said amount may be forfeited to the said BOARD OF DIRECTORS as liquidated damages.

All bids are to be marked in accordance with Section 102.9 of the Uniform Standard Specifications and addressed to the Chief Engineer and General Manager, Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona 85009.

As provided for in the Agenda Information Form authorizing the Invitation to Bid.

PRINCIPLE ITEMS AND APPROXIMATE QUANTITIES

<u>QUANTITY</u>	<u>UNIT</u>	<u>DESCRIPTION</u>
1,348	CY	Structural Concrete
70	LF	96" R.G.R.C.P. Class II, with fittings and bulkhead
244,000	EA	Reinforcing Steel

PROPOSAL

TO THE BOARD OF DIRECTORS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PHOENIX, ARIZONA

Gentlemen:

The following Proposal is made for constructing Squaw Peak Water Treatment Plant Bypass Line in the County of Maricopa, State of Arizona.

The following Proposal is made on behalf of

and no others. Evidence of authority to submit the Proposal is herewith furnished. The Proposal is in all respects fair and is made without collusion on the part of any person, firm, or corporation mentioned above, and no member or employee of the Board of Directors is personally or financially interested, directly or indirectly, in the Proposal, or in any purchase or sale of any materials or supplies for the work in which it relates, or in any portion of the profits thereof.

The Undersigned certifies that the approved Plans, Special Provisions, Forms of Contract, Bonds, and Sureties authorized by the Board of Directors and constituting essential parts of this Proposal, have been carefully examined and also that the site of the work has been personally inspected.

The Undersigned declares that the amount and nature of the work to be done is understood and that at no time will misunderstanding of the Plans, Construction Specifications, Special Provisions, or conditions to be overcome, be pled. On the basis of the Plans, Construction Specifications, Special Provisions, the Forms of Contract, Bonds, and Sureties proposed for use, the Undersigned proposes to furnish all the necessary machinery, equipment, tools, apparatus, and other means of construction, to do all the work and to furnish all the materials in the manner specified and to finish the entire project within the time hereinafter proposed and to accept, as full compensation therefore, the sum of various products obtained by multiplying each unit price, herein bid for the work or materials, by the quantity thereof actually incorporated in the complete project, as determined by the Engineer or Architect.

The Undersigned understands that the quantities mentioned herein are approximate only and are subject to increase or decrease and hereby proposes to perform all quantities of work, as either increased or decreased, in accordance with the provisions of the Specifications, at the unit price bid in the Bidding Schedule.

The Undersigned further proposes to perform all extra work that may be required on the basis provided in the Specifications and to give such work personal attention and to secure economical performance.

The Undersigned further proposes to execute the Contract Agreement and furnish satisfactory Bonds and Sureties within five (5) days of receipt of Notice of Proposal acceptance, **TIME BEING OF THE ESSENCE**. The Undersigned further proposes to begin work as specified in the Contract attached hereto, and to complete the work within 180 calendar days from the effective date specified in the Notice to Proceed, and maintain at all times a Payment and Performance Bond, approved by the Board of Directors, each in an amount equal to one hundred percent of the contract amount. This Bond shall serve not only to guarantee the completion of the work on the part of the Undersigned, but also to guarantee the excellence of both workmanship and material and the payment of all obligations incurred, said Bonds and Sureties to be in full force and effect until the work is finally accepted and the provisions of the Plans, Specifications, and Special Provisions fulfilled.

A Proposal Guaranty in the amount and character named in the Invitation to Bid is enclosed amounting to not less than five (5) percent of the total bid, which Proposal Guaranty is submitted as a guaranty of the good faith of the Bidder and the Bidder will enter into written contract, as provided, to do the work, if successful in securing the award thereof; and it is hereby agreed that if at any time other than as provided in the Proposal requirements and conditions the Undersigned should withdraw his Proposal, if the Proposal is accepted and there should be failure on the part of the Undersigned to execute the Contract and furnish satisfactory Bonds and Sureties as herein provided, the Flood Control District of Maricopa County in either of such events, shall be entitled and is hereby given the right to retain the said Proposal Guaranty as liquidated damages.

The Undersigned acknowledges receipt of the following addenda and has included their provisions in the proposal:

Addendum No. _____	Dated _____

The Undersigned has enclosed the required bid security to this Proposal.

BIDDING SCHEDULE

PROJECT: Squaw Peak Water Treatment Plant

CONTRACT: FCD 90-31

ITEM NO.	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT COST (IN WRITING) AND /100 DOLLARS	UNIT COST (NUMBERS)	EXTENDED AMOUNT
211-1	Fill Construction	1	LS			
505-1	Reinforced Concrete, in place	1,348	CY			
505-2	Demolition and Removals at Existing Pump Station No. 2 Forebay	1	LS			
515-1	Miscellaneous Steel	1	LS			
520-1	Miscellaneous Aluminum	1	LS			
1500-1	96" R.G.R.C.P. Class II, with Fittings and Bulkhead	70	LF			
1500-2	Relocate Existing 4" PVC Waterline, 6" and 8" Sludge Lines	1	LS			
1500-3	Connection of 96" R.G.R.C.P. at Existing Junction Structure	1	LS			
1600-1	Relocate Existing Electric	1	LS			
1600-2	Concrete Duct Bank	380	LF			
1600-3	Electrical Manholes/Pull Boxes	6	EA			

TOTAL BID AMOUNT: _____

IF BY AN INDIVIDUAL:

_____	_____
(NAME - TITLE)	(ADDRESS)
	DATE _____
	(PHONE) _____

IF BY A FIRM OR PARTNERSHIP:

_____	_____
(FIRM NAME)	(FIRM ADDRESS)
BY: _____	DATE _____
(NAME - TITLE)	(PHONE) _____

** Name and Address of Each Member:

_____	_____
_____	_____
_____	_____

** The name and post office address of each member of the firm or partnership must be shown.

IF BY A CORPORATION:

_____	_____
(CORPORATE NAME)	(CORPORATION ADDRESS)
BY: _____	DATE: _____
	(PHONE) _____

TITLE: _____

* Incorporated under the Laws of _____

Names and Addresses of Officers:

_____	_____
(PRESIDENT)	(ADDRESS)
_____	_____
(SECRETARY)	(ADDRESS)
_____	_____
(TREASURER)	(ADDRESS)

* The name of the State under which the laws of the Corporation was chartered and names, title, and business address of the President, Secretary, and Treasurer must be shown.

SUBCONTRACTOR LISTING

As required in Section 102.6 of the Special Provisions, the following is a listing of Subcontractors and material suppliers that are to be used in the event the undersigned should enter into contract with the Owner. This is not an exhaustive or inclusive list.

(Signature) _____

SURETY BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, _____, as Principal, (hereinafter called the Principal), and the _____, a corporation duly organized under the laws of the State of _____, as Surety, (hereinafter called the Surety), are held and firmly bound unto the Flood Control District of Maricopa County as Obligee, in the sum of five percent (5%) of the total amount of the bid of Principal, submitted by him to the Flood Control District of Maricopa County, for the work described below, for the payment of which sum, well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, and administrators, successors and assigns, jointly and severally, firmly by these presents, and in conformance with A.R.S. Sec. 34-201(A)(3).

WHEREAS, the said Principal is herewith submitting its proposal for FCD Contract 90-31; Squaw Peak Water Treatment Plant Bypass Line in the County of Maricopa, State of Arizona.

NOW, THEREFORE, if the Flood Control District of Maricopa County shall accept the proposal of the Principal and the Principal shall enter into a contract with the Flood Control District of Maricopa County in accordance with the terms of such proposal and give such Bonds and Certificates of Insurance as specified in the Standard Specifications with good and sufficient Surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter into such contract and give such Bond and Certificates of Insurance, if the Principal shall pay to the Flood Control District of Maricopa County the sum of money set forth above as liquidated damages for failure of the Principal to enter into the contract, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, A.D., 1990.

Principal

Title

Witness:

Surety

Title

Witness:

VERIFICATION OF LICENSE

Pursuant to A.R.S. Sec. 32-1169, I hereby state that I hold a current contractor's license, duly issued by the office of the Registrar of Contractors for the State of Arizona, said license has not been revoked, that the license number is: _____; that my privilege license number (as required by A.R.S. Sec. 42-1305) is: _____; and that, if any exemption to the above licensing requirements is claimed;

(1) The basis for the claimed exemption is: _____ and;

(2) The names(s) and license number(s) of any general, mechanical, electrical, or plumbing contractor(s) to be employed on the work are:

IT IS UNDERSTOOD THAT THE FILING OF AN APPLICATION CONTAINING FALSE OR INCORRECT INFORMATION CONCERNING AN APPLICANT'S CONTRACTOR'S LICENSE OR PRIVILEGE LICENSE WITH THE INTENT TO VOID SUCH LICENSING REQUIREMENTS IS UNSWORN FALSIFICATION PUNISHABLE ACCORDING TO A.R.S. SEC. 13-2704.

DATE: _____ SIGNATURE OF LICENSEE: _____

COMPANY: _____

MINORITY AND WOMEN-OWNED BUSINESS ENTERPRISE PROGRAM

- A. The following conditions will apply in the calculation of the percentage attainment:
1. All MBE/WBE firms used in attainment of the goal must be certified with the Maricopa County Minority Business Office which is located in the Maricopa County Highway Department building, 3325 West Durango Street, Phoenix. In addition, only those firms certified at least seven calendar days prior to the bid opening will be considered in the attainment of the goal.
 2. Prime contractor subcontracts to MBE or WBE:
The MBE/WBE amount to be applied to the goal will be based on that portion (dollar value) of the contract that the MBE/WBE performs. For example, if a prime contractor subcontracts work amounting to \$100,000 of a contract for which the total project cost is \$1,000,000. the MBE/WBE participation will be credited as 10 percent.
 3. Prime Minority Contractor:
An MBE/WBE prime contractor will be credited with the MBE/WBE participation for that portion of the contract which they themselves perform plus that portions subcontracted to other MBE/WBE firms. For example, if an MBE/WBE prime contractor proposes to perform 50 percent of a project quoted at \$1,000,000 and subcontracts 25 percent to an MBE firm and 25 percent to a non-MBE/WBE firm, MBE/WBE participation will be credited as 75 Percent, or \$750,000.
 4. Minority-Non-Minority Joint Venture:
A joint venture consisting of MBE/WBE participation and non-MBE/WBE business enterprises, functioning as a prime contractor, will be credited with minority participation on the basis of the percentage of profit accruing to the MBE/WBE firm. For example, if a MBE/WBE and non-MBE/WBE joint venture proposes to perform 50 percent of a \$1,000,000 project and 50 percent of the joint venture profits (\$500,000) are to accrue to the MBE/WBE partner in the joint venture, MBE/WBE participation will be credited at 25 percent or \$250,000.
 5. Lower Tier Non-MBE/WBE Participation:
MBE/WBE subcontractors proposing to further subcontract to non-MBE/WBE contractors shall not have that portion of subcontracting activity considered when determining the percentage of MBE/WBE participation.

6. MBE/WBE Suppliers:

Any MBE/WBE supplier that manufactures or substantially alters the material or product it supplies will have that portion of activity considered when determining the percentage of MBE/WBE participation. Any MBE/WBE Wholesaler, Distributor, or Jobber that does not manufacture or substantially alter the materials or product it sells will be limited to 20 percent of the sale price when determining the percentage of MBE/WBE participation.

B. Required forms:

An affidavit is included as part of this section. The form must be completed within seven calendar days after the Notice of Award of Contract. The low bidder is required to submit a Minority/Women-Owned Business Enterprise Program MBE/WBE Participation Affidavit listing the MBE/WBE participation by MBE/WBE firm and the related dollar value of the MBE/WBE contract.

C. Requests for Pay:

Each Request for Pay must be accompanied by a Maricopa County Minority/Women-Owned Business Enterprise Program MBE/WBE Participation Report. The final pay request shall include a listing of total contract MBE/WBE participation.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
MINORITY/WOMEN-OWNED BUSINESS ENTERPRISE PROGRAM

MBE/WBE PARTICIPATION ASSURANCES
AFFIDAVIT

The undersigned, fully cognizant of the Flood Control District of Maricopa County MBE/WBE Program requirements and of the goal established, hereby certifies that in the preparation of this bid,

(the entity submitting the bid)

(CHECK ONE)

- ___ Will meet the established goal for participation by Minority/Women-Owned Business Enterprises.
- ___ Will provide the necessary documentation to Minority Business Office to establish that a good faith effort was made.
- ___ Will not participate in the MBE/WBE Program.

The bidder will specify its MBE/WBE participation on the Intended Participation Affidavit or provide documentation of its good faith efforts not later than 4:00 p.m., the seventh calendar day following the bid opening. The required affidavit shall be obtained by the apparent first and second low bidders from the Minority Business Office, Maricopa County Highway Department Building, 3325 West Durango Street, Phoenix, Arizona 85009, following the opening and reading of bids; a sample affidavit form for reference purposes follows.

Name of Firm

Signature

Title

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
MINORITY/WOMEN-OWNED BUSINESS ENTERPRISE PROGRAM
Actual Minority/Women-owned Participation

Name of Prime Contractor

FCD 90-31

Project Number

Contact Person

Total Amount of Contract

Street No.

City State Zip

<u>Minority/Women-owned Firm</u>	<u>Principal</u>	<u>Address</u>	<u>Type of Work</u>	<u>Subcontract Amount</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

The undersigned has entered into a formal agreement with the minority contractors/suppliers listed above in the execution of this contract with the Flood Control District of Maricopa County.

Signature

Title

Date

Copy to: Minority Business Office
Maricopa County Highway Department
3325 West Durango Street
Phoenix, Arizona 85009

FCD Contract 90-31

MARICOPA COUNTY
MINORITY/WOMEN-OWNED BUSINESS ENTERPRISES PROGRAM

MBE/WBE PARTICIPATION REPORT
(To be attached with Request for Pay)

Date: _____

Contractor: _____
Contact Person: _____
Address: _____

Telephone: _____

Project: Squaw Peak Water Treatment Plant
Bypass Line
Contract Number: 90-31
For Pay Period of: _____

Subcontractor: _____
Person to Contact: _____
Address: _____
Telephone Number: _____

Type of Firm: _____
Class of Work: _____

Subcontract Amount: _____
Amount Earned _____
(Commission) This Period: _____
Total Earned by This Subcontractor: _____

Total MBE/WBE Contract Goal, %: 10
Total Cumulative MBE/WBE
Participation on This Contract, %: _____

MBE/WBE subcontract payment made
during this reporting period (yes or no): _____

cc: Minority Business Office
Maricopa County Highway Building
3325 West Durango Street
Phoenix, Arizona 85009

CONTRACT AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 1990, by and between FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, hereinafter called the OWNER, acting by and through its BOARD OF DIRECTORS, and

_____ hereinafter called the CONTRACTOR.

WITNESSTH: That the said CONTRACTOR, for and in the consideration of the sum of _____ to be paid to him by the OWNER, in the manner and at the times hereinafter provided, and of the other covenants and agreements herein contained, hereby agrees for himself, heirs, executors, administrators, successors, and assigns as follows:

ARTICLE I - SCOPE OF WORK: The CONTRACTOR shall construct, and complete in a workmanlike and substantial manner and to the satisfaction of the Chief Engineer and General Manager, a project for the Flood Control District of Maricopa County, designated as FCD Contract 90-31; Squaw Peak Water Treatment Plant Bypass Line, and furnish at his own cost and expense all necessary machinery, equipment, tools, apparatus, materials, and labor to complete the work in the most substantial and workmanlike manner according to the Plans and Construction Specifications on file with the Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona, and such modifications of the same and other directions that may be made by the Flood Control District of Maricopa County as provided herein.

ARTICLE II - CONTRACT DOCUMENTS: The Construction Specifications (Invitation to Bid, Plans, Standard Specifications and Details, Special Provisions, Addenda, if any, Proposal, Affidavits, Performance Bond, Payment Bond, Certificates of Insurance, and Change Orders, if any,) are by this reference made a part of this Contract and shall have the same effect as though all of the same were fully inserted herein.

ARTICLE III - TIME OF COMPLETION: The CONTRACTOR further covenants and agrees at his own proper cost and expense, to do all work as aforesaid for the construction of said improvements and to completely construct the same and install the material therein, as called for by this agreement free and clear of all claims, liens, and charges whatsoever, in the manner and under the conditions specified within the time, or times, stated in the proposal pamphlet.

ARTICLE IV - PAYMENTS: For and in consideration of the faithful performance of the work herein embraced as set forth in the Contract Documents, which are a part hereof and in accordance with the directions of the OWNER, through its Engineer and to his satisfaction, the OWNER agrees to pay the said CONTRACTOR the amount earned, computed from actual quantities of work performed and accepted or materials furnished at the unit bid price on the Proposal made a part hereof, and to make such payment in accordance with the requirements of A.R.S. Sec. 34-221, as amended. The CONTRACTOR agrees to discharge its obligations and make payments to its subcontractors and suppliers in accordance with A.R.S. Sec. 32-1129.

ARTICLE V - TERMINATION: The OWNER hereby gives notice that pursuant to A.R.S. Sec. 38-511(A) this contract may be cancelled without penalty or further obligation within three years after execution if any person significantly involved in initiation, negotiation, securing, drafting or creating a contract on behalf of the OWNER is, at any time while the contract or any extension of the contract is in effect, an employer agent of any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the Chief Engineer and General Manager of the OWNER is received by all of the parties to the contract. In addition, the OWNER may recoup any fee for commission paid or due to any person significantly involved in initiation, negotiation, securing, drafting or creating the contract on behalf of the OWNER from any other party to the contract arising as a result of the contract.

ARTICLE VI - NEGOTIATION CLAUSE: Recovery of damages related to expenses incurred by the CONTRACTOR for a delay for which the OWNER is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract, shall be negotiated between the CONTRACTOR and the OWNER. This provision shall be construed so as to give full effect to any provision in the contract which requires notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

ARTICLE VII - COMPLIANCE WITH LAWS: The CONTRACTOR is required to comply with all Federal, State and local ordinances and regulation. The CONTRACTOR's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform Control Act of 1986 for all personnel that the CONTRACTOR and any subcontractors employ to complete this project. It is understood that the OWNER shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

ARTICLE VIII - MBE/WBE PROGRAM: Flood Control District of Maricopa County will endeavor to ensure in every way possible that minority and women-owned business enterprises shall have every opportunity to participate in providing professional services, purchased goods, and contractual services to the Flood Control District of Maricopa County without being discriminated against on the grounds of race, religion, sex, age, or national origin.

ARTICLE IX - ANTI-DISCRIMINATION PROVISION: The CONTRACTOR agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, or handicap and further agrees not to engage in any unlawful employment practices. The CONTRACTOR further agrees to insert the foregoing provision in all subcontracts hereunder.

IN WITNESS WHEREOF: Five (5) identical counterparts of this Contract, each of which shall for all purposes be deemed an original thereof, have been duly executed by the parties hereinabove named, on the date and year first above written.

PARTY OF THE FIRST PART

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PARTY OF THE SECOND PART

BY: _____
Printed Name

BY: _____
CHAIRMAN, BOARD OF DIRECTORS

BY: _____
Signature

DATE: _____

Title
DATE: _____

Tax Identification Number

RECOMMENDED BY:

ATTEST:

CHIEF ENGINEER AND GENERAL MANAGER
FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

CLERK OF THE BOARD

DATE: _____

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.

BY: _____
GENERAL COUNSEL, FLOOD CONTROL
DISTRICT OF MARICOPA COUNTY

DATE: _____

STATUTORY PAYMENT BOND PURSUANT TO TITLE 34
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____
(hereinafter called the Principal), As Principal, and _____

_____ a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, in the County of Maricopa, State of Arizona (hereinafter called the Oblige), in the amount of _____

_____ dollars (\$_____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with Flood Control District of Maricopa County, dated the ____ day of _____, 1990, for FCD Contract 90-31; Squaw Peak Water Treatment Plant Bypass Line, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall promptly pay all monies due to all persons supplying labor or materials to him or his subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of said Title, Chapter, and Article, to the extent as if it was copied at length herein.

The prevailing party or any party which recovers judgement on this bond shall be entitled to such reasonable attorney's fees as may be fixed by the court or a judge thereof.

Witness our hands this _____ day of _____, 1990.

PRINCIPAL SEAL

BY: _____

AGENCY OF RECORD

SURETY SEAL

BY: _____

BOND NUMBER. _____

POWER OF ATTORNEY SEAL

BY: _____

STATUTORY PERFORMANCE BOND PURSUANT TO TITLE 34
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____
(hereinafter called the Principal), As Principal, and _____

_____ a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, in the County of Maricopa, State of Arizona, in the amount of _____ dollars (\$ _____), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with Flood Control District of Maricopa County, dated the ____ day of _____, 1990, for FCD Contract 90-31; Squaw Peak Water Treatment Plant Bypass Line, which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extension thereof, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of said Title, Chapter, and Article, to the extent as if it was copied at length herein.

The prevailing party in a suit on this bond shall be entitled to such reasonable attorney's fees as may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 1990.

AGENCY OF RECORD

AGENCY ADDRESS

BOND NUMBER _____

POWER OF ATTORNEY

SEAL

BY: _____

PRINCIPAL

SEAL

BY: _____

SURETY

SEAL

BY: _____

CERTIFICATE OF INSURANCE

CONTRACT FCD 90-31

PROJECT TITLE Squaw Peak WTP Bypass Line

NAME AND ADDRESS OF INSURANCE AGENCY	INSURANCE COMPANIES AFFORDING COVERAGES
	Company Letter A
	Company Letter B
NAME AND ADDRESS OF INSURED	Company Letter C
	Company Letter D
	Company Letter E
	Company Letter F
	Company Letter G

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE AND ARE IN FORCE AT THIS TIME.

COMPANY LETTER	TYPE OF INSURANCE	POLICY NUMBER	EXPIRATION DATE	LIMITS OF LIABILITY IN \$1,000 MINIMUM each occurrence	
	COMMERCIAL GENERAL <input checked="" type="checkbox"/> LIABILITY FORM <input checked="" type="checkbox"/> PREMISES OPERATIONS <input checked="" type="checkbox"/> CONTRACTUAL <input checked="" type="checkbox"/> BROAD FORM PROPERTY DAMAGE <input checked="" type="checkbox"/> EXPLOSION & COLLAPSE <input checked="" type="checkbox"/> PRODUCTS/COMPLETED OPERATIONS HAZARD <input checked="" type="checkbox"/> UNDERGROUND HAZARD <input checked="" type="checkbox"/> INDEPENDENT CONTRACTORS <input checked="" type="checkbox"/> PERSONAL INJURY			BODILY INJURY per person PROPERTY DAMAGE each occurrence	Combined Single Limit 5,000
	COMPREHENSIVE AUTO <input checked="" type="checkbox"/> LIABILITY & NON-OWNED			SAME AS ABOVE	
	<input type="checkbox"/> EXCESS LIABILITY			NECESSARY IF UNDERLYING NOT ABOVE MINIMUM	
	<input checked="" type="checkbox"/> WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY			STATUTORY each accident	\$100
	<input checked="" type="checkbox"/> OTHER	+3,000,000 as specified in Special Provisions, Section 107.8.			
	<input checked="" type="checkbox"/> OTHER	In addition to the Flood Control District of Maricopa County, Maricopa County, the City of Phoenix, and John Carollo Engineers shall also be named as additional insureds.			

Except for Workers' Compensation Insurance, the Flood Control District of Maricopa County is added as an additional insured in respect to liability arising in any manner out of the performance of any contract entered into between the insured and the Flood Control District or liability arising out of any services provided or duty performed by any party as required by statute, law, purchase order, or otherwise required. It is agreed that any insurance available to the named insured shall be primary of other sources that may be available. It is further agreed that no policy shall expire, be cancelled, or materially changed to effect the coverage available to the District without thirty (30) days written notice to the District. THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 3335 West Durango Street
 Phoenix, Arizona 85009

DATE ISSUED _____

AUTHORIZED REPRESENTATIVE _____

It is further agreed that:

The Contractor hereby agrees to indemnify and save harmless the Flood Control District of Maricopa County, Maricopa County, City of Phoenix and John Carollo Engineers or any of its departments, agencies, officers or employees, from and against all loss, expense, damage or claim of any nature whatsoever which is caused by any activity, condition or event arising out of the performance or nonperformance of any of the provisions of this Agreement. The Flood Control District of Maricopa County, Maricopa County, City of Phoenix and John Carollo Engineers shall in all instances be indemnified against all liability, losses and damages of any nature for or on account of any injuries to or death of persons or damages to or destruction of property arising out of or in any way connected with the performance or nonperformance of this Agreement, except such injury or damage as shall have been occasioned by the negligence of the Flood Control District of Maricopa County, Maricopa County, City of Phoenix, and John Carollo Engineers. The above cost of damages incurred by the Flood Control District of Maricopa County, Maricopa County, City of Phoenix, and John Carollo Engineers or any of its departments, agencies, officers or employees, or others aforesaid shall include in the event of an action, court costs, expenses for litigation and reasonable attorney's fees.

Firm

Date

Principal

Title

**CONSTRUCTION SPECIAL PROVISIONS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
SQUAW PEAK WATER TREATMENT PLANT
BYPASS LINE**

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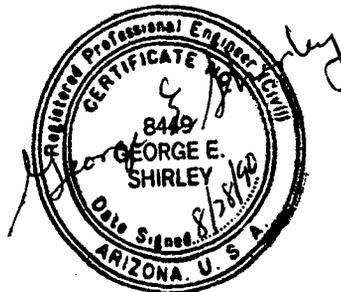


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CONSTRUCTION SPECIAL PROVISIONS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
SQUAW PEAK WATER TREATMENT PLANT
BYPASS LINE

LOCATION OF THE WORK

This project is located at the Squaw Peak Water Treatment Plant (WTP), 2202 East Maryland Avenue, Phoenix, Arizona.

PROPOSED WORK

The work consists of construction of a bypass line around the existing presedimentation basin, relocation of an electrical duct bank, and other miscellaneous items of work required for the completion of the project.

STANDARD SPECIFICATIONS

The provisions of MAG Uniform Standard Specifications and Details for Public Works Construction dated 1979, as modified by the City of Phoenix, which are not altered or modified by the Drawings, General Conditions or by these Special Provisions or by any subsequently issued Addendum shall apply to the Contract even though the Contractor's attention is not specifically drawn to such provisions.

PRECEDENCE OF CONTRACT DOCUMENTS

City of Phoenix Supplements to MAG Specifications and Details will govern over the MAG Standard Specifications and Details. In case of a discrepancy or conflict, Project Plans will govern over the City of Phoenix Supplements, the MAG Standard Specifications and Details. These Construction Special Provisions will govern over the City of Phoenix Supplements, the MAG Standard Specifications and Details, and the Project Plans.

PAYMENT

Payment will be made for only those items listed in the Proposal and will not be made in accordance with the measurement and payment provisions of the Standard Specifications where this differs from the items listed in the Proposal. All materials and work necessary for completion of this project are to be included in Proposal items. Any work or material not specifically referred to in these items is considered incidental to the item and included in the unit price.

NEGOTIATION CLAUSE

Recovery of damages related to expenses incurred by the Contractor for a delay for which the Flood Control District of Maricopa County is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the Contract, shall be negotiated between the Contractor and the Flood Control District of Maricopa

County. This provision shall not be construed to void any provision in the Contract which requires notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

WORK STANDARDS

The Contractor shall comply with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330) as supplemented by Department of Labor Regulations (29 CFR Part 5).

CONTRACT TIME

The Contractor shall start work within seven (7) calendar days after Notice to Proceed. Contract duration shall be 180 calendar days.

Work shall be accomplished in conjunction with the dry-up schedule of the Arizona Canal. The published dry-up schedule of the Arizona Canal by Salt River Project is November 24, 1990 through December 22, 1990. However, there is a possibility this dry-up window could be shifted either earlier or later. The Contractor shall keep informed of the Salt River Project dry-up schedule and shall be responsible for adjusting his work schedule to meet the actual dry-up window. Also see "Work Involved with Existing Plant" for description of such work.

It is anticipated that a Contract for construction of the Arizona Canal Diversion Channel will be awarded before the completion of this Contract. However, construction of the Arizona Canal Diversion Channel through the plant site is not expected to occur prior to October 1991.

WATER, LIGHT, POWER, HEAT, TELEPHONE

All water for construction purposes, drinking water, lighting, temporary electric power, heat and telephone service shall be arranged for and provided for the requirements of the work by the Contractor at his expense.

WORK UNDER OTHER CONTRACTS

Another Contractor working on associated facilities will interface with this Work during the life of this Contract. This other Project includes the relocation of waterlines and electrical duct banks, and the construction of two vehicular access bridges across the future ACDC.

This Contractor shall cooperate with these Contractors to perform the Work at a minimum cost and time delay for all involved. In the event of lack of agreement the Engineer shall determine how and where the interface shall be made and his decision shall be final.

WORK INVOLVED WITH EXISTING PLANT

The Work under this Contract must be accomplished while the existing plant is in operation. The work that is involved with the existing plant must be done so that operation of the existing plant will not be jeopardized or materially reduced in efficiency as a result of the work under this Contract.

CONSTRUCTION SPECIAL PROVISIONS

CONTRACT NO. FCD 90-31

BypassLine-SquawPeak

Work on this Contract must be coordinated with the operation of the plant. The Contractor shall notify the Engineer in writing of the Contractor's planned procedure for each specific alteration of existing facilities before the alteration begins. The Contractor shall provide three written notices to the treatment facility manager for any work that will impact plant operation. These notices are required 60, 30, and 7 days prior to starting work and shall note impact on operation, start of impact, and duration. The Contractor shall not begin an alteration until specific permission has been granted by the treatment facility manager in each case to the Engineer. The Engineer will coordinate the Contractor's planned procedure with the treatment facility manager. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be completed as quickly as possible and with as little delay as possible.

Any operational functions of the existing plant that are required to be performed to facilitate the work of the Contractor shall be performed by the plant personnel only, or as otherwise directed by the Engineer.

The plant operation and maintenance personnel will cooperate in every way that is practicable in order to expedite the work of the Contractor; however, if it is necessary for the proper operation or maintenance of portions of the plant, the Contractor shall reschedule his operations so that his work will not conflict with necessary operations or maintenance of the plant.

The Contractor shall maintain access roads to all parts of the existing plant.

The work under this Contract that is involved with the existing plant is indicated in the Contract Documents.

In particular, the Contractor shall schedule the work to adhere to the following construction constraints:

1. Connections into existing Pump Station No. 1 forebay and existing presedimentation basins inlet box shall be made and completed during the 1990 (November 24 through December 22) dry-up.
2. Modification to existing Pump Station No. 2 forebay and associated demolition shall be completed during the 1990 canal dry-up. Existing sluice gate on the opening from existing pre-sedimentation basin to Forebay No. 2 in the area of the modification shall be salvaged and reinstalled at the south end of existing Pump Station No. 2 forebay where a gate is missing.
3. Existing electrical duct banks, waterlines, and miscellaneous plant utilities shall be relocated so as to minimize impacts on the operation of the existing plant, and prior written notification and permission are required, as detailed above.

4. Upon completion and testing of the project, the Contractor shall remove the steel bulkhead at the inlet junction structure and the concrete bulkhead at the Pump Station No. 1 forebay, dispose of all material, and clean the structure.

PROGRESS SCHEDULE

The Contractor shall submit his proposed work progress schedule to the Chief Engineer and General Manager for approval before starting the work.

EXISTING FACILITIES AND SEQUENCING

The Contractor is cautioned that the Work to be performed under this Contract is within and adjacent to existing, operational water treatment facilities as described in "Work Involved With Existing Plant". To accommodate these conditions, the Contractor shall incorporate into his Progress Schedule sequencing which shall take into account the constraints set forth hereinbefore and in the following paragraphs.

The Progress Schedule is required to show plant and treatment process shutdown periods. In addition, the Progress Schedule shall show the sequencing of Work to adhere to the constraints as described above. All materials and equipment (including emergency equipment) necessary to expedite and complete the Work shall be on hand prior to the shutdown, and shall be verified by the Engineer. Testing and sterilization of facilities, where required, shall be performed before plant or process start-up.

MATERIAL SOURCES

Select material, aggregate base and mineral aggregate shall be obtained from commercial sources. The Contractor shall pay all royalties, or any other charges or expenses, incurred in connection with the securing and hauling of the material. The Contractor will be required to furnish the Engineer with a list of his proposed commercial sources prior to use, and shall present certificates stating that the material produced from any commercial sources is in accordance with the Uniform Standard Specifications and these Special Provisions.

101.2 DEFINITIONS AND TERMS

Change the definition of the Budget Project to read as follows: A project financed by funds set aside in the annual budget or otherwise approved by the Board of Directors of the Flood Control District of Maricopa County.

Change the definition of Engineer to read as follows: The Chief Engineer and General Manager of the Flood Control District of Maricopa County acting directly or through his duly authorized representative.

Change the definition of Owner to read as follows: The Flood Control District of Maricopa County, acting through its legally constituted officials, officers or employees.

ADDENDA AND SUBMISSION OF BIDDING SCHEDULE

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any addenda have been issued. This may be accomplished by calling 602-262-1501. Any addendum issued, if not already bound into the Special Provisions, must be included as a part of the Special Provisions, and any quantities on the Bidding Schedule requiring change shall be adjusted by pen and ink to the new figure.

Bids that do not include appropriate addenda and show appropriate changes to the Bidding Schedule shall be invalid.

102.5 PREPARATION OF PROPOSAL

The bidder's Arizona State Contractor's License number and classification shall be shown on the Proposal. The possession of such a license is a bidding requirement; in addition, the Contractor may be required to provide certification of prior satisfactory completion for similar construction.

103.6 CONTRACTOR'S INSURANCE

Concurrently with the execution of the contract, the Contractor shall furnish a Certificate of Insurance using the included Certificate or one of equal wording, that names the additional insureds as set out in the Certificate. The Certificate shall also name the additional insureds as Certificate Holders. The types of insurance and the limits of liability shall be as indicated on the included form.

103.6.1 (D)

Add additional insureds as indicated on the included Certificate of Insurance.

103.6.2

Contractor's indemnification shall conform to the indemnification agreement included with the contract.

104.20 SUBSURFACE INVESTIGATION

Soil borings and geotechnical investigations have been performed at the site of the work for this and related projects by Thomas-Hartig & Associates, Inc. The results of these investigations are contained in three reports dated May 1989, November 1989, and February 1990. Complete reports are on file with the Engineer, and may be reviewed by the Bidders or the Contractor at a location designated by the Engineer. Prospective Bidders are encouraged to review these documents.

The Engineer makes no representation as to the correctness of the information contained in the boring logs, nor as to the location of the boring holes, nor that the report represents a cross section of the material to be encountered in performing excavation and earthwork on the Project. Any use made of the report by the Bidders or the Contractor is at the sole risk of such bidders or the Contractor who have the responsibility to satisfy themselves independently from other sources regarding the character and amount of rock, gravel, sand, silt, organic materials, ground-water, and all other material to be encountered in the work to be performed.

The use of this information shall be at the Bidders' or the Contractor's discretion. The Bidders or the Contractor shall recognize the fact that the determination of the types and sizes of material was limited by the size of the auger or drill used to drill the hole. Bidders or Contractor shall make whatever other investigations as are necessary in order to determine to their or his satisfaction the conditions that exist.

105.2 PLANS AND SHOP DRAWINGS

Prior to purchase or fabrication, the Contractor shall furnish the Engineer with shop drawings, layout diagrams, manufacturer's catalog data, and detailed information, in sufficient detail to show complete compliance with all specified requirements, covering but not limited to the following items:

1. Detailed sequence of construction
2. Concrete mix designs
3. Reinforcing steel
4. Shoring and bracing plans for structure excavation
5. Reinforced concrete pipe layout and design data

The number of copies of shop drawings required for approval shall be five (5). One copy will be returned to the Contractor.

Drawings for shoring and bracing plans for structure excavation shall be prepared by and bear the seal and signature of a licensed Professional Civil or Structural Engineer in the State of Arizona.

When submitted for the Engineer's review, shop drawings shall bear the Contractor's certification that he has reviewed, checked, and approved the shop drawings, and that they are in conformance with the requirements of the Contract Documents. The Engineer will not review any submittals which do not bear the Contractor's certification.

After the review has been completed, the above drawings, lists, samples, design calculations, and other data, shall become a part of the Contract Documents and the fabrications furnished shall conform to the submittal.

Review of material and layout drawings consists of review for general conformity to Plans and Specifications and in no way relieves the Contractor or the supplier from responsibility for the correctness of the drawings.

Deviations or changes from Plans or Specifications must be called out as such and will require review by the Engineer for approval or rejection.

105.6 COOPERATION WITH UTILITIES

An attempt has been made to determine the location of all underground utilities and drainage pipes, culverts and structures; however, it shall be the Contractor's responsibility to cooperate with the pertinent utility companies so that any obstructing utility installation may be adjusted.

Should the Contractor's operations result in damage to any utility, he shall assume full responsibility for such damage. The Contractor will coordinate with these utilities as required.

The following phone numbers should put the Contractor in contact with the proper personnel:

Flood Control District.....	262-1501
Salt River Project (Water Operation Support) - Tim Phillips.....	236-2956
Salt River Project (Distribution Engineering Dept.) - Chuck Hughes.....	236-2090
Salt River Project (Substation Engineering Dept.) - Gary Frere.....	236-3154
Location Staking (U.S. West, SRP).....	263-1100
City of Phoenix - Squaw Peak Water Treatment Plant Senior Treatment Facilities Supervisor - Tom Martin.....	262-4983
City of Phoenix Streets and Traffic - Marshal Hollen....	262-6565
City of Phoenix Water and Wastewater - Gerald Arakaki...	261-8229
U.S. West Communications - Curt Sayer.....	831-4777

105.8 CONSTRUCTION STAKES, LINES AND GRADES

The project control lines and benchmark elevation are shown on the drawings and will be established by the Engineer. The Contractor shall establish offset stakes and temporary benchmarks for referencing the designated construction lines and grades. The Contractor shall provide all rough grade, fine grade, and structural reference lines and shall be responsible for their conformance with the Plans and Specifications.

Survey work shall be performed by a qualified and experienced surveyor under the supervision of a licensed land surveyor.

The Contractor shall furnish field books to be used for recording survey data and field notes. These books shall be available for inspection by the Engineer at any time and shall become the property of the Engineer upon completion of the work.

The Engineer reserves the right to make inspections and random checks of any portion of the staking and layout work. If, in the Engineer's opinion, the work is not being performed in a manner that will maintain proper control and accuracy of the work, he will order any or all of the staking and layout work redone at no additional cost.

105.10 INSPECTION OF WORK

Work will be subject to City of Phoenix inspection and acceptance prior to final acceptance by the Engineer.

SOURCE OF MATERIALS AND QUALITY: The Contractor shall guarantee the construction work for one year against faulty materials, faulty workmanship and failure to meet the requirements of the Specifications. Said guarantee by the Contractor shall not apply to damage caused by earthquakes or other acts of God, land subsidence, or faulty operations or any abuse of the structures by others.

106.5 CONTRACTOR'S STAGING AREA

The Contractor shall confine the storing of materials and location of temporary facilities to the area shown on the Drawings.

107.2 PERMITS

The Contractor shall be responsible for obtaining all permits and licenses, pay all charges, fees, taxes and give all notices necessary and incidental to the due and lawful prosecution of the work. Permits for earth moving may be obtained from the Bureau of Air Pollution Control, Maricopa County Department of Health Services, 1845 East Roosevelt, telephone number 258-6381.

A permit from the Salt River Valley Water Users Association for work in their right-of-way shall be obtained by the Contractor from the Flood Control District.

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

107.5.2 COMPLIANCE WITH THE ARIZONA HAZARD COMMUNICATION STANDARD:

The Owner will provide the Contractor with Material Safety Data Sheets (MSDS) for any products known to exist on the site that have physical hazards or are deemed health hazards.

The Contractor will provide a copy of Owner-provided MSDS to all subcontractors.

The Contractor will provide the Owner and all subcontractors with MSDS for any products that have physical hazards or are deemed health hazards that will be brought onto the site or created on the site by either the Contractor or by any subcontractors.

The Contractor will provide the Owner with a statement certifying that all personnel (Contractor and subcontractor) employed by the Contractor or by a subcontractor on the job site have received the required Hazard Communication Standard training.

107.8 USE OF EXPLOSIVES

The Contractor is not required to use any particular excavation method. However, if the Contractor elects to use blasting methods of excavation, he shall assume responsibility for any damage resulting from such blasting operations. Costs of blasting, pre-blast survey, written report, reservoir testing, and miscellaneous related costs shall be included under Item No. 206.1 of the Bidding Schedule. The Contractor is cautioned that there is an existing City of Phoenix Reservoir No. 3 located approximately 500 feet north of the project site, and that the potential exists for damaging that reservoir. The reservoir was originally constructed in the mid-1960's and was repaired and re-lined in 1986. The reservoir shall be leakage-tested prior to the start of any blasting and again after completion of all blasting operations by the Contractor. Initial leakage test shall not be begun prior to January 2, 1991, and as allowed by the City of Phoenix Water and Wastewater Department.

If blasting procedures are used for excavation of the project, the reservoir shall be tested in accordance with the following procedures. Reservoir shall be filled to maximum water elevation (1283.0). An evaporation pan shall be affixed to the interior handrailing of the reservoir and filled to a minimum of four (4) inches. The reservoir and evaporation pan water levels shall be observed by the Engineer and Contractor over a period of 7 days, during which time no water shall be added or withdrawn from the reservoir. The total amount the water level

recedes during the first test, adjusted for evaporation, shall be recorded and compared to the leakage test performed after the blasting operations are completed. If the total depth the water level recedes after the second test, adjusted for evaporation, is less than 115 percent of that of the first test, the reservoir shall be considered to be undamaged.

If the level drop of the second test is greater than 115 percent of the first test, the reservoir shall be drained, inspected by a registered professional engineer, acceptable to the Owner, who shall make recommendations for repair of the reservoir based on his observations. Contractor shall pay the cost of any water used in testing and re-filling, cost of inspection if necessary, cost of repairs, cost of re-disinfection and placing the reservoir back into service, and cost of repeat leakage testing to verify that repairs have reduced the leakage to less than 115 percent of the rate measured by the Contractor's initial test.

The Contractor shall comply with relevant federal, state and local laws, regulations and codes, provisions of MAG, including the Uniform Fire Code, and ADOT Standard Specification Sections 107.11 and 203-3.03(c) (1) and (c) (2). Under Article 77, Section 77.105 of the Uniform Fire Code, a public liability insurance policy in the amount of \$3,000,000.00 will be required. Certificate of insurance shall be provided at the time of execution of the Contract. In addition, the following requirements apply to this project if blasting procedures are used for excavation of the project.

1. The Contractor shall engage a professional engineer, acceptable to the Owner, registered in the State of Arizona, to perform a preblasting survey of all existing structures (particularly including the City of Phoenix Reservoir No. 3) within 750 feet on the north, and 300 feet in all other directions of the area to be subjected to blasting. The survey should include as a minimum:
 - a. A detailed review of existing site conditions.
 - b. A detailed examination and documentation of the condition of the existing structures including exterior slabs and pavement. Photographs shall be taken to show condition of existing structures.
 - c. Establishment of horizontal and vertical survey control points.
 - d. Establishment of blast monitoring stations at critical locations.
 - e. Written report of this survey, which shall be submitted prior to the start of blasting activities.
2. During construction the Contractor shall maintain detailed records of blasting which shall include as a minimum:
 - a. Charge weight.
 - b. Location of blast points and distances from existing structures.
 - c. Delays.

- d. Response of blast monitoring (written report by Contractor's Engineers, including all records and results of blasting activities).
3. Blast monitoring shall include as a minimum the particle velocity readings at the closest structure to the blast points.
4. Small charges shall be used initially to establish a site specific relationship between charge weight, distance and response. The particle velocity of all stations monitored must be maintained at less than 2.0 inch/sec.
5. Alternate blasting methods may be proposed by the Contractor's blasting engineer.

108.5 LIMITATION OF OPERATIONS

Should the Contractor or subcontractor elect to perform any work before or after regular working hours, on weekends, or legal holidays, any charges incurred by the District for inspection of the work, surveys, or tests of materials will be deducted from monies due or to become due to the Contractor.

108.9 FAILURE TO COMPLETE ON TIME

The actual cost per calendar day incurred by the District for construction engineering and inspection services on this project will be added to the daily charges as indicated by TABLE 108, LIQUIDATED DAMAGES, as shown in the MAG Uniform Standard Specifications (not in the Phoenix Supplement), and will be deducted from monies due or to become due to the Contractor for each and every calendar day that work shall remain uncompleted after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer. The Contractor may contact the District to review the anticipated fee schedule for the construction engineering and inspection services if desired. Nothing contained in this provision shall prohibit the District from deducting from monies due or to become due to the Contractor any other costs incurred by the District directly attributable to the delay in completing this Contract.

In addition, if the Contractor fails to complete the construction of the bypass line and the placement of existing utilities back into service within the milestone deadlines identified in "Work Involved With Existing Plant" and "Contact Time", the actual cost incurred by the City of Phoenix for the loss of treatment capacity at the plant and the costs to supply water from alternative sources will be deducted from monies due or to become due to the Contractor for each and every calendar day that work shall remain uncompleted after the time specified for completion of the work. These charges shall be in addition to the liquidated damage charges specified above if these delays result in failure to complete the overall project on time.

109 MEASUREMENTS AND PAYMENTS

Under MAG Section 109.5.1 Equipment, the following exception is made:

Unless a prior written agreement has been made, the Flood Control District of Maricopa County will not pay move-in/move-out costs and standby equipment rates.

201 CLEARING AND GRUBBING

The work under this item consists of removal and disposal of all trees, stumps, and objectionable materials within the limits of the work areas, including pipeline relocations and removals, and other areas designated on the Plans. Materials shall be disposed of off-site. Also see Section 205.6 in these Special Provisions. This is not a pay item.

205.6 DISPOSAL OF SURPLUS MATERIAL

All surplus and/or waste material may be disposed of at the Contractor's discretion subject to the following conditions:

- A. If the City landfills are used, the Contractor shall pay the normal dumping fee.
- B. If private property within the City limits is used, the Contractor shall obtain written permission from the property owner and deliver a copy of this agreement to the Engineer prior to any hauling or dumping. All disposal and grading shall be in strict conformance with the City of Phoenix Grading and Drainage Ordinance. The Contractor shall obtain and pay for the necessary permit(s).
- C. If the surplus material is disposed of outside the City limits, the Contractor shall comply with all applicable laws/ordinances of the agency concerned and be responsible for all cost incurred.

No measurement or direct payment will be made for the hauling and disposal of surplus and/or waste material; the cost shall be incidental to the cost of the project.

206 STRUCTURAL EXCAVATION AND BACKFILL

Structural excavation and backfill shall conform to Section 206 of the Uniform Standard Specifications.

Structural backfill shall be compacted to not less than 100 percent density when tested and determined by AASHTO T-99 and T-191, or ASTM D-2922 and D-3017. When AASHTO T-99, method A or B, and T-191 are used for density determination, MAG Detail 190 will be used for rock correction.

Payment for all work under this section, including testing, shall be included at the lump sum bid for Item 206-1, Structural Excavation and Backfill.

206.1 EXCAVATION SUPPORT

- A. General: Contractor shall support the faces of excavations and shall protect structures and improvements in the vicinity of excavations from damage due to settlement of soils.
1. The provisions specified hereunder shall be understood:
 - a. to complement, and not to substitute or diminish, the obligations of Contractor for the furnishing of a safe place of work pursuant to the provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for the protection of the work, structures, and other improvements.
 - b. to represent a minimum requirement
 - 1) for the number and types of means needed to maintain soil stability,
 - 2) for the strength of such required means, and
 - 3) for the methods and frequency of maintenance and observation of the means used for maintaining soil stability.
 2. Excavation support shall include sheeting, shoring, bracing, sloping, and other means and procedures, such as routing and disposing of surface runoff, required to maintain the stability of soils.
- B. Contractor shall provide excavation support in trenches for the protection of workers from the hazard of caving ground.
- C. Excavation supports shall be provided:
1. Where, as a result of excavation work and an analysis performed pursuant to general engineering design practice, as defined hereinafter,
 - a. the excavated face or surrounding soil mass may be subject to slides, caving, or other type of failure, or
 - b. the stability and integrity of structures and other improvements may be compromised by settlement or shifting of soils.
 2. For trenches five feet and deeper.

D. References:

1. American Institute of Steel Construction, Inc., Manual of Steel Construction, herein referenced as the Steel Manual.
2. International Conference of Building Officials, Uniform Building Code, herein referenced as the UBC.

E. Definitions: As used under this title of Excavation Support, general engineering design practice shall be understood to mean the general engineering design practice in the area of the Project performed in accordance with recent engineering literature on the subject of excavation support.

1. Where general engineering design practice is specified it shall be understood that the design shall be performed, and the drawings and calculations shall be signed, by a civil or structural engineer registered in the state where the Project is located.
 - a. The design calculations shall disclose clearly the assumptions made, the criteria followed, and the stress values used for the various materials.
 - b. Where requested by Engineer, Contractor shall furnish acceptable references substantiating the appropriateness of the design assumptions, criteria, and stress values.

F. Submittals:

1. For trench excavation, Contractor shall submit, in advance of excavation of trenches 5 feet or more in depth, detailed plans showing the design of excavation support for worker protection.
2. For excavations other than trenches, Contractor shall submit:
 - a. An analysis performed pursuant to general engineering design practice, as specified hereinbefore, identifying the conditions under which excavation support will be required. This analysis shall be submitted in advance of and shall cover:
 - 1) Excavations 2 feet or more in depth adjacent to structures, and
 - 2) Excavations 5 feet or more in depth at other locations.

b. For excavations that will require excavation support, in accordance with the determination made under the preceding subparagraph a., Contractor shall submit excavation support design and details pursuant to general engineering design practice, as specified hereinbefore.

1) The same procedure shall be followed for subsequent changes to the excavation support design.

G. Design Criteria:

1. Excavation support shall be designed in accordance with general engineering design practice.
2. Steel members shall be designed in accordance with the Steel Manual.
3. Design involving materials other than steel shall be in accordance with the UBC.
4. Excavation support shall be designed in accordance with soil characteristics and design recommendations contained in a written report issued and signed by a civil or soil engineer registered in the state where the Project is located.
 - a. A copy of the written report shall be available at the site of the Project for Engineer's review.
 - b. The civil or soil engineer shall be retained by Contractor.
5. Where Contractor elects to design excavation support allowing materials to bear stresses higher than those prescribed in the referenced publications, the increase in such stresses shall not exceed 10 percent of the value of the prescribed stresses.

H. Performance Requirements: Appropriate design and procedures for construction and maintenance shall be used to minimize settlement of the supported ground and to prevent damage to existing structures and other improvements. Such design and procedures shall include:

1. Using stiff support systems.
2. Following an appropriate construction sequence.

3. Preventing soil loss through or under the support system.
 - a. The support system shall be tight enough to prevent loss of soil and shall be extended deep enough to prevent heave or flow of soils from the supported soil mass into the excavation.
4. Providing surface runoff routing and discharge away from the excavations.
5. Not anchoring the support system to structures and other improvements.
6. Not applying support system loads to structures and other improvements.
7. Not changing existing soil loading on structures and other improvements.

I. Installation:

1. Excavation support shall be installed as indicated in the approved submittals.
2. Excavation, including trenching, shall not begin until the excavation support submittals have been approved by the Engineer and until the materials necessary for the installation are on site.

J. Maintenance:

1. Where loss of soil occurs, Contractor shall plug the gap in the support system and shall replace the lost soil with suitable fill material.

211 FILL CONSTRUCTION

Fill construction shall consist of raising the existing grades where indicated to provide cover over new concrete box, as shown on the Plans and in accordance with Section 211 of the Uniform Standard Specifications.

Payment for all work under this section shall be at the lump sum price bid for Item 211-1 - Fill Construction.

350 REMOVAL OF EXISTING IMPROVEMENTS

Removal of existing pipelines, pavement, duct banks, and structures shall be as indicated on the Plans and in accordance with Section 350 of the MAG Standard Specifications. Removals shall be nonpay items.

Temporary removed sections of existing fence shall be stored for later reinstallation after the work is complete.

401 TRAFFIC CONTROL

Attention is directed to Section 401.2, Traffic Control Devices, of the MAG Standard Specifications, and to the City of Phoenix Traffic Barricade Manual. This is not a pay item.

505 CONCRETE STRUCTURES

Construction of new concrete structures shall conform to the Plans, Division 3 of these Specifications and (for the concrete box structure) to ADOT details referenced on the plans. MAG Section 505 is superceded by Division 3 of these Specifications. Concrete and reinforcing steel shall be as specified in Division 3 of these Specifications. Division 3 includes some concrete classes which are not applicable to this project.

Modification to the existing Pump Station No. 2 forebay shall conform to the Plans, and MAG Specifications as amended by these Specifications. Payment for structural demolition and modifications to existing Pump Station No. 2 shall be made at the lump sum bid for Item No. 505-2. Payment for structural concrete for this item shall be included in Item No. 505-1.

New concrete bypass channel shall be leakage-tested for watertightness. The bypass channel shall be filled to a water depth of 10.0 feet. The Contractor shall add water and maintain the water level for a period of 48 hours prior to the start of the test. The bypass channel water level shall be observed by the Contractor and by the Engineer over a period of 7 days, during which time no water shall be added or withdrawn from the channel. The total amount the water level recedes during the test shall be 0.1 feet. If the water level drops more than 0.1 feet in 7 days, the Contractor shall drain and repair the channel and retest until the allowable leakage rate of 0.1 feet is achieved. Cost of leakage testing including water, and any repairs necessary to achieve a watertight channel shall be included in the unit price bid for Item 505-1, Structural Concrete.

Payment for new concrete bypass structure and related items shall be at the unit prices bid for Items No. 505-1, Structural Concrete, 505-3, Reinforcing Steel, 515-1, Miscellaneous Steel, and 520-1, Miscellaneous Aluminum.

515 STRUCTURAL AND MISCELLANEOUS METALS

Structural and miscellaneous metals shall be as specified in Division 5 of the Specifications.

600 WATER AND SEWER

Pipeline construction shall be in accordance with MAG Section 600 and DIVISION 15 of the Special Provisions. In the case of conflict, DIVISION 15 shall apply.

Payment for RCP, installed, shall be made at the unit price bid for Item 1500-1. Payment for relocating existing PVC waterline and existing 6-inch and 8-inch sludge lines shall be at the lump sum price bid for Item 1500-2. Payment for work involved with installing the RCP connection at existing junction structure, including water removal and cleanup, concrete removal, grouting and patching, steel bell ring, bulkhead, and slide plate at structure shall be made at the lump sum price bid for Item 1500-3.

601 TRENCH EXCAVATION, BACKFILLING, AND COMPACTING

Trench excavation, backfilling, and compacting shall conform in their entirety to the requirements of Section 601 of the Uniform Standard Specifications. Pipe bedding shall be as shown on the Plans.

Mechanical compaction methods only shall be used, unless approved, in writing, by the Engineer.

601.2.8 DEWATERING TRENCHES AND STRUCTURES

This item covers the entire project except as specified elsewhere in these Special Provisions.

Any water encountered during installation of the new work shall be disposed of by the Contractor in such a manner as will not cause damage to public or private property or constitute a nuisance or menace to the public. The Contractor shall furnish, install, and operate pumps, pipes, appliances, and equipment of sufficient capacity and so located as to keep all excavations and accesses free from water while work is in progress, and during weekends and holidays when required by the Engineer. The Contractor shall provide all means or facilities necessary to conduct water to the pumps. This is not a pay item.

611 DISINFECTING WATER MAINS

Disinfecting water mains shall be in accordance with MAG Section 611. Cost of disinfecting relocated potable water line shall be included in amount bid for Item 1500-2.

DIVISION 3

CONCRETE

030000 GENERAL

Except as otherwise specified, concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements of these Specifications and suitable to the specific conditions of placement. The proportions of materials shall be such as to secure the lowest water-cement ratio which is consistent with good workability, a plastic, cohesive mixture, and one which is within the specified slump range. The proportion of fine and coarse aggregate shall be such as not to produce harshness in placing nor honeycombing in the structures.

030001 WATERTIGHTNESS OF CONCRETE WORK

It is the intent of this Specification to secure for every part of the Work concrete and grout of homogeneous structure, which when hardened will have the required strength, watertightness, and resistance to weathering.

It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces. Construction, contraction, and expansion joints have been positioned in structures, and curing methods specified, for the purpose of reducing the number and size of these expected cracks, due to the normal expansion and contraction expected from the specified concrete mixes. Class A and Class B concrete shall be watertight. Cracks which develop in walls or slabs shall be repaired. Cracks which show any signs of leakage shall be repaired until all leakage is stopped.

Visible cracks, other than hairline cracks and crazing, in the following areas shall be pressure grouted with low viscosity epoxy as specified herein as Epoxy Injection System: floors and walls of water bearing structures; walls and overhead slabs of passageways or occupied spaces, the outside of which are exposed to weather or may be washed down and are not specified to receive a separate waterproof membrane; slabs over water channels, wet wells, reservoirs, and other similar surfaces not specified to receive a separate waterproof membrane.

Walls or slabs, as above, that leak or sweat because of porosity or cracks too small for successful pressure grouting, shall be sealed on the water or weather side by coatings of a surface sealant system, as specified elsewhere herein.

Grouting or sealing as specified above shall be continued until the structure is watertight and shall remain watertight for not less than one year after final acceptance or date of final repair, whichever occurs later in time.

030002 JOINTS AND BONDING

As far as practicable the concrete work shall be constructed as a monolith. The locations of contraction, construction, and other joints are indicated on the Plans or specified herein. Where not specified or indicated otherwise, all slabs and walls shall have construction joints at intervals not greater than 30 feet. In order to preserve the strength and watertightness of the structures, no other joints shall be made except as the Engineer may authorize. At construction joints, the concrete in place shall be thoroughly cleaned of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of a bush hammer or heavy sandblasting, after which the surfaces shall be washed just prior to the succeeding concrete placement. Immediately prior to resuming concrete placing operations, a bed of grout not less than 1/2 inch in thickness nor more than 1 inch in thickness shall be thoroughly spread over the horizontal joint surfaces. Keyways in joints shall be provided as indicated on the Plans. Material for keyways shall be steel, plastic or lumber treated with form release coating, applied in accordance with the manufacturer's published instructions.

Construction joints shall be washed free of sawdust, chips, and other debris after forms are built and immediately before the concrete placement. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, a vacuum cleaner shall be used for their removal, after which the cleaned surfaces shall be flushed with water. A cleanout hole shall be provided at the base of each wall and column for inspection and cleaning.

In any case where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, the surface of the set concrete shall first be coated with epoxy bonding agent Concessive No. 1001 LPL as manufactured by Adhesive Engineering; Sikadur Hi-Mod as manufactured by Sika Chemical Corporation; or equal. This material shall be applied in accordance with the manufacturer's published instructions. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

Expansion, contraction, and construction joints shall be constructed where and as indicated on the Plans. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials, shall be as specified elsewhere herein.

The Contractor shall schedule the placing of concrete in such a manner as to complete any single placing operation to a construction, contraction, or expansion joint. Special care shall be taken to insure that concrete is well consolidated around and against waterstops and that waterstops are secured in the proper position.

030100 WORKMANSHIP AND METHODS

Concrete work, including detailing of reinforcing, shall be in accordance with the best standard practices and as set forth in the ACI Building Code, Manuals, and Recommended Practices.

CONSTRUCTION SPECIAL PROVISIONS

CONTRACT NO. FCD 90-31

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All concrete materials shall be so delivered, stored, and handled as to prevent damage to the materials and the inclusion of foreign substances. Packaged materials shall be delivered and stored in original containers until ready for use. Material containers or materials showing evidence of water or other damage shall be rejected.

030101 MEASUREMENTS OF MATERIALS

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities of the individual item can be measured to within 1 percent of the desired amount of that item. Cement in unbroken standard packages (sack) need not be weighed, but bulk cement and fractional packages shall be weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be capable of control of water quantities to an accuracy of 1 percent of the desired amount. All measuring or weighing devices shall be subject to review and acceptance by the Engineer, and shall bear a valid seal of the Sealer of Weights and Measures having jurisdiction.

030102 CONCRETE PROPORTIONS AND CONSISTENCY

The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around the reinforcement without excessive vibration and without permitting the materials to segregate or free water to collect on the surface.

The ratio of coarse aggregate to fine aggregate shall be not less than 1.0 nor more than 2.0 for all concrete with the exception of Class CE.

To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from a source which will insure uniform quality, moisture content, and grading during any single day's operation. Aggregate shall be delivered to the Work and handled in such a manner that variations in moisture content will not interfere with the steady production of concrete of the specified degree of uniformity and slump.

See Table A of this Division for the concrete mix water to cement ratio, minimum cement content, and slump range.

It is the Contractor's responsibility to control and adjust the concrete batch weights so as to secure the maximum yield, yet at all times the Contractor shall maintain the proportions of the concrete mix within the specified limits.

If it is required, in the opinion of the Engineer, the mixture shall be modified within the limits set forth in these Specifications.

030103 CONCRETE MIXES

Prior to placement of concrete the Contractor shall submit to the Engineer for review and acceptance full details, including mix design calculations for the concrete mix he proposes to use for each class of concrete. After acceptance, the Contractor shall have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by a testing laboratory acceptable to the Engineer. The trial batches shall be prepared using the specified cement and aggregates proposed to be used for the project which conform to these Specifications. The trial batch shall be of sufficient quantity to determine slump, workability, consistency and finishing characteristics, and to provide sufficient 6-inch by 12-inch test cylinders prepared in accordance with ASTM C 31 for the following tests.

Eight test cylinders shall be compression tested in accordance with ASTM C 39, four at 7 days and four at 28 days. A ratio between 7-day and 28-day strength will be established for the mix and the 7-day strength may be taken as a satisfactory indication of the 28-day strength provided the effects on the concrete of temperature and humidity between the seventh and 28-day are taken into account.

Full information shall be submitted for each of the cylinders as to the mix and slump as determined in accordance with ASTM C 143.

If the trial batch tests do not meet the project specifications for slump, strength, workability, consistency, and finishing, the concrete mix design proportions and, if necessary, source of aggregate shall be changed and additional trial batches and tests shall be made until an acceptable trial batch is produced that meets the project specifications.

Test batches and tests required to establish trial batches and acceptability of materials shall be paid for by the Contractor.

After acceptance, the mixes shall not at any time be changed without reacceptance by the Engineer, except that at all times the batching of water shall be adjusted to compensate for the free moisture content of the fine aggregate. The total water content of each of the type concretes shall not exceed those listed in Table A of this Division. Satisfactory means shall be provided at the batching plant for checking the moisture content of the fine aggregate. The details of concrete mixes submitted for review shall include information on the correction of the batching for varying moisture contents of the fine aggregate.

If there is a change in the aggregate source, or if there is a change in aggregate quality from the same source, the Contractor shall submit to the Engineer for review and acceptance a new set of design mixes covering each class of concrete, and a new trial batch and test program shall be undertaken as hereinbefore specified. Each new trial batch and test program shall be at the expense of the Contractor.

030104 TESTING OF CONCRETE

During the progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with the standards of quality specified herein. These tests shall be made in accordance with ASTM C 31, ASTM C 39, and ASTM C 172. Test cylinders will be made and delivered to the laboratory by the Engineer and the testing expense will be borne by the Owner.

Not less than three cylinder specimens, 6-inch by 12-inch, will be tested for each 150 cubic yards of each grade of concrete with a minimum of three specimens for each grade placed and not less than three specimens for each half day's placement. One cylinder will be broken at 7 days and two at 28 days.

The Contractor shall test the slump of concrete using a slump cone in accordance with the requirements of ASTM C 143. The Contractor shall provide the test equipment. Concrete that does not meet the Specification requirements as to slump shall not be used but shall be removed from the job. The Contractor shall test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the Engineer.

The Contractor shall make provisions for and furnish all concrete for the test specimens, and provide manual assistance to the Engineer in preparing said specimens. The Contractor shall be responsible for the care of and providing curing conditions for the test specimens in accordance with ASTM C 31.

030105 ENFORCEMENT OF STRENGTH REQUIREMENT

Concrete is expected to reach a higher compressive strength than that which is indicated in Table A as compressive strength. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the required strength and no individual strength test falls below the required strength by more than 500 psi. Where an individual strength test falls below the required strength by more than 500 psi, the Engineer shall have the right to ask for additional curing of the affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318, all at the Contractor's expense. If the additional curing does not bring the average of three cores taken in the affected area to at least the strength specified, the Engineer may require strengthening of the affected portions of the structures by means of additional concrete or steel or he may require replacement of these affected portions, all at the Contractor's expense.

030110 CLASSES OF CONCRETE

Concrete shall be of five classes, herein referred to as Classes A, B, C, D, and CE which shall be as specified herein and which shall be used in the respective places called for in these Specifications. These classes

of concrete shall have a minimum weight of 140 pounds per cubic foot. Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and when noted on the Plans. Class B concrete may be used where Class A concrete is required, if high-early-strength is desired, at the Contractor's option. Class D concrete shall be used for precast concrete items. Class CE shall be used for electrical conduit encasements. All other concrete, unless specified or noted otherwise, shall be Class A concrete.

TABLE A
CONCRETE
WITHOUT AIR ENTRAINMENT

<u>Class</u>	<u>Compressive Strength @ 28-Days (psi)</u>	<u>Max. Net* Water To Cement Ratio By Weight</u>	<u>Min. Cement* Per Yard Of Concrete (Pounds)</u>	<u>Consistency Range In Slump (Inches)</u>
A	4,000	0.53	564	2 to 4**
B Type III cement	4,000	0.53	564	2 to 4**
C	2,500	0.71	423	3 to 6
D	4,500	0.45	658	2 to 4
CE	2,500	0.71	564	3 to 6

* See 030180.

** NOTE: Slump for slabs, decks, walks, and beams shall be not more than 3-1/2 inches.

Any concrete that is pumped shall meet all the requirements of these Specifications. In no case shall concrete be placed which shows a slump outside the limits indicated in the table.

Classes A, C, D, and CE concrete shall be made with Type II low alkali. Class B concrete shall be made with Type III low alkali cement. See Admixtures for allowable admixtures.

030120 AGGREGATE

All concrete aggregates shall be sound, uniformly graded, and free of deleterious material in excess of the allowable amounts specified.

The Contractor shall furnish the Engineer certified copies in triplicate of commercial laboratory tests of all samples of concrete aggregates submitted. Tests on concrete aggregates shall indicate as a minimum all specified tests. All concrete aggregate tests shall be at the Contractor's expense.

Aggregate shall be sampled and graded in accordance with ASTM D 75 and C 136.

Sieves for testing grading of aggregates shall have square openings.

Sieve analyses of the fine and coarse aggregates being used shall be furnished the Engineer in triplicate at any time there is a significant change in the grading of the materials, and in any event, shall be furnished at least every three weeks. If such sieve analyses indicate a significant change in the materials, the Engineer may require that a new mix design be submitted for review and acceptance before further placing of concrete.

If either fine or coarse aggregate is to be batched from more than one bin, analyses shall be furnished for each bin, and a composite analysis made up from these, using the proportions of materials to be used in the mix.

The unit weight of fine and coarse aggregate shall be of a unit weight which will produce in place concrete with a weight of not less than 140 pounds per cubic foot.

030121 FINE AGGREGATE

Fine aggregate for concrete or mortar shall consist of clean, natural sand or of sand prepared from crushed stone or crushed gravel. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed 3 percent.

	<u>Test Method</u>	<u>Percent</u>
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or chert	ASTM C 295	1
Clay lumps	ASTM C 142	1

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than the standard color when tested in accordance with ASTM C 40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00 when tested in accordance with ASTM C 125. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C 33. Aggregate soundness shall comply with the requirements of ASTM C 33 when tested in accordance with ASTM C 88. Aggregate shall comply with the reactivity requirements contained in ASTM C-33 when tested in accordance with ASTM C-227.

030122 COARSE AGGREGATE

Coarse aggregate shall consist of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances. Thin or elongated pieces having a length greater than five times the average thickness shall not exceed 15 percent by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed 2 percent.

	<u>Test Method</u>	<u>Percent</u>
Soft fragments or particles	ASTM C 851	2
Shale or chert	ASTM C 295	1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than No. 200 sieve	ASTM C 117	1/2 *

* Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount shall be 1 percent.

Aggregate when tested in accordance with ASTM C 88 for soundness shall have a loss not greater than 10 percent when tested with sodium sulfate.

Abrasion loss of coarse aggregate shall not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131. Coarse aggregate reactivity shall not exceed the limits specified in the appendix of ASTM C 33 when tested in accordance with ASTM C 289.

Except as otherwise specified or authorized in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C 33, Size No. 57. Coarse aggregate for Class CE concrete for encasement of electrical conduits shall be graded as specified in ASTM C 33, Size No. 8; concrete utilizing this aggregate will be equal to Class C concrete in all other respects, and will be designated as Class CE.

030150 WATER

Water for concrete, washing aggregate, and curing concrete shall be clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances. Water shall not contain more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion for conventional reinforced concrete. Water for prestressed or post-tensioned concrete shall not contain more than 650 milligrams per liter of chlorides calculated as chloride ion, nor more than 800 milligrams per liter of sulfates calculated as sulfate ion.

030160 PORTLAND CEMENT

Except as otherwise specified all Portland cement shall conform to the specifications and test for Portland cement ASTM C 150, Types II or III, Low Alkali. Low alkali Portland cement shall contain not more than 0.6 percent total alkali. The word "alkali" shall be taken to mean the sum of sodium oxide and potassium oxide calculated as sodium oxide. The determination for total alkali shall be made by the method set forth in ASTM C 114. Only one brand of Portland cement shall be used for exposed concrete in any individual structure.

030161 PORTLAND-POZZOLAN CEMENT

Portland-pozzolan cement shall conform to the requirements of ASTM C 595, Type IP(MS). In addition, the Portland cement clinker used in the manufacture of Portland-pozzolan cement shall be Type II low alkali as specified in 030160. The pozzolan content of Portland-pozzolan cement shall not exceed 15 percent by weight. Only one brand of Portland-pozzolan cement shall be used for exposed concrete in any individual structure.

030162 TESTING AND PACKAGING

Certified copies in triplicate of mill tests representative of each shipment of cement shall be furnished to the Engineer for verification of compliance with these Specifications. Mill tests on cement shall include a report on alkali content.

030180 ADMIXTURES - GENERAL

Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. Admixtures used shall be compatible with the concrete and other admixtures. Admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight shall not be used. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.

030182 FLY ASH POZZOLAN ADMIXTURE

Pozzolan, conforming to the requirements of ASTM C 618, Class F, may be used as an admixture in concrete made with Type II Portland cement. The loss on ignition for pozzolan shall not exceed 4 percent. Pozzolan may replace Portland cement at a ratio of 1.2 pounds fly ash for each pound of Portland cement replaced. A maximum of 15 percent by weight of the minimum quantities of Portland cement listed in Table A under 030110 CLASSES OF CONCRETE may be replaced with pozzolan. Pozzolan shall not be used as an admixture in concrete made with Portland-pozzolan cement. Pozzolan shall be sampled and tested in accordance with ASTM C 311. In computing the water-cement ratio and the cement content per cubic yard of concrete, cement weight shall be considered to be the weight of Portland cement plus 83 percent of weight of fly ash. Certificates in triplicate shall be furnished to the Engineer by the pozzolan supplier. The certificates shall identify the source of the pozzolan and shall attest to its compliance with the requirements of ASTM C 618.

030183 WATER REDUCING ADMIXTURE

A water reducing admixture may be used at the Contractor's option. Such admixtures shall conform to ASTM C 494, Type A or Type D. The admixture shall not contain air entraining agents. Admixture shall be in liquid form before adding to the concrete mix. No decrease in cement shall be permitted as a result of a water reducing admixture.

030200 FORMS AND ACCESSORIES

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated on the Plans. It is intended that the surface of the concrete after stripping shall present a smooth, hard, and dense finish that will require a minimum amount of finishing. Sufficient number of forms shall be provided so that the work may be prosecuted rapidly and present a uniform appearance in form patterns and finish. Forms shall be clean and free from all dirt, debris, concrete, etc. and shall be coated with an acceptable form oil if required, prior to use or reuse.

The design of all concrete forms, falsework, and shoring shall be the responsibility of the Contractor and the design and installation of these items shall comply with all local, State, and Federal regulations.

Information on the Contractor's proposed forming system shall be submitted in such detail as the Engineer may require to assure himself that the intent of the Specifications can be complied with by the use of the proposed system. Except as otherwise specified, or accepted in writing by the Engineer, only forming systems by manufacturers with a minimum of five years' experience shall be considered.

Vertical forms shall remain in place a minimum of 24 hours after the concrete is placed. If, after 24 hours, the concrete is sufficiently hardened to resist surface or other damage, the vertical forms may be removed. Other forms supporting concrete and shoring shall remain in place as follows:

Sides of footings	24 hours (minimum)
Vertical sides of beams, girders, and similar members	48 hours (minimum)
Slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Shoring for slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Wall bracing	Until concrete strength of the slab laterally supporting the wall reaches 85 percent of the specified strength

Forms shall not be removed from concrete which has been placed with outside ambient air temperature below 50 degrees F until the concrete has attained 85 percent of specified strength as determined by test cylinders stored in the field under equivalent conditions as the concrete structure.

No heavy loading on green concrete (85 percent of specified strength) will be permitted. Immediately after forms are removed, the surface of the concrete shall be carefully examined, and any irregularities in the surface shall be repaired and finished as specified hereinafter.

030201 FORM TIES

Form ties for the forming system selected shall be the cone-snap tie or flat bar type as manufactured by a recognized manufacturer of concrete forming equipment. Forms shall be tied together at not less than 2-foot centers vertically and horizontally. Wire ties or wood spreaders of any form shall not be used. Ties shall be of a type that will accurately tie, lock, and spread the forms. Forms and ties shall be designed to withstand concrete pressures without bulging, spreading, or lifting of the forms. The form tie shall be of such design that when the forms are removed no metals shall be within 3/4 inch of any surface. Holes in the forms for ties shall not allow leakage during placement of concrete.

030202 BUILT-UP PLYWOOD FORMS

Built-up plywood forms may be substituted for a prefabricated forming system subject to the following minimum requirements: full sized (4-foot by 8-foot) plywood sheets must be used except where smaller pieces will cover an entire area. Plywood sheets shall be 5-ply, 3/4-inch, made with 100 percent waterproof adhesive, and the finish surface shall be coated or overlaid with a surface which is impervious to water and the alkaline calcium and sodium hydroxide of cement. Studding shall be not less than 2-inch by 4-inch lumber spaced at 16 inches or 24 inches on center. Closer spacing may be required depending upon the strength requirements of the forms, in order to prevent any bulging surfaces on the faces of finished concrete work. Studs shall be installed perpendicular to the grain of the exterior plys of the plywood sheets. Wales shall be formed of double 2-inch by 4-inch lumber as a minimum. Studding and wales shall contain no loose knots and shall be free of warps, cups, and bows. The number of reuses of forms will depend upon the durability of the surface coating or overlay used, and the Contractor's ability to maintain the forms in a condition which will produce a flat, smooth, hard, dense finish on the concrete when stripped. Alternate combinations of plywood thickness and stud spacing may be submitted to the Engineer for review and acceptance.

030203 STEEL OR STEEL FRAMED FORMS

Steel forms shall be rigidly constructed and adequately braced for minimum deflection of the finish surface. The finish surface shall be flat without bows, cups, or dents.

Steel framed plywood forms shall be rigidly constructed and braced with joints fitting closely and smoothly. Plywood paneling shall be 5-ply, 5/8-inch or 3/4-inch, made with 100 percent waterproof adhesive, and the finish surface shall be coated or overlaid with a surface which is

impervious to water and the alkaline calcium and sodium hydroxide of cement. The number of reuses will depend upon the durability of the surface coating or overlay used.

Built-up plywood forms, as specified above, may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through the forms.

030204 INCIDENTALS

Where not shown otherwise on the Plans and Typical Details, all external angles of walkways, slabs, walls, beams, columns, and openings shall have a 3/4-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip and external angles of walkways, walls, and slabs at expansion, contraction, and construction joints shall be a 1/2-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip. Reentrant angles may be left square. Level strips shall be installed at the top of all wall concrete placements to maintain a true line at all horizontal construction joints.

Keyways shall be constructed as detailed on the Plans. Material for keyways shall be steel, plastic, or lumber treated with form coating, applied according to label directions.

Pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Plans or as required, shall be encased in the concrete. Dovetail anchors or ties shall be used in conjunction with the slots or inserts for the various materials as specified under their respective sections and as may be necessary for the required work.

030205 BRACING AND ALIGNMENT OF FORMS

It shall be the Contractor's responsibility to limit deviations in line and grade to tolerances which will permit proper installation of all structurally embedded items or mechanical and electrical equipment and piping.

All formwork shall be securely braced, supported, tied down, or otherwise held in place to prevent any movement of formwork. Adequate provisions shall be made for uplift pressure, lateral bulging of forms, and deflection of forms for slabs and beams.

When a second lift is placed on hardened concrete, special precautions shall be taken in the form work at the top of the old lift and bottom of the new lift to prevent spreading, vertical or horizontal displacement of forms; and to prevent grout "bleeding" on finished concrete surfaces. Pipe stubs, anchor bolts, and other embedded items shall be set in the forms where required.

Concrete beams or slabs shall not be placed directly on masonry walls so that any of the weight of the concrete either before or after the concrete has set is on the masonry wall, unless the masonry wall is identified on the Plans as "bearing wall."

No concrete shall be placed until all forms have been thoroughly checked by the Contractor for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items. All cracks, openings, or offsets at joints in the formwork which are 1/16-inch or larger shall be closed by tightening the forms or by filling with an acceptable crack filler.

030206 TOLERANCES

It is the intent that the finished concrete conforms to the shapes, lines, grades, and dimensions indicated on the Plans. It shall be the responsibility of the Contractor to comply with the intent of these Specifications, but it is also recognized that there will be occasions when some deviation will occur or be required. It shall therefore be agreed that the maximum deviation from true line and grade shall not exceed the tolerances listed below at the time of acceptance of the project.

- A. In general all tolerances shall comply with ACI 117-81, paragraphs 2.0 through 2.2 and paragraphs 4.0 through 4.5, except as modified in the following. All slabs shall be uniformly sloped to drain when a slope is indicated. Slabs which are indicated to be level shall have a maximum deviation of 1/8 inch in 10 feet without any apparent changes in grade.
- B. On circular tank walls, the Contractor may deviate from the finish line indicated on the Plans by the use of chord lengths not to exceed 2 feet.
- C. All inserts shall be set to the tolerances required for the proper installation and operation of the equipment or systems to which the insert pertains. The following shall be considered maximum tolerances.

<u>Item</u>	<u>Maximum Tolerance, inches</u>
Sleeves and inserts	plus 1/8 minus 1/8
Projected ends of anchor bolts	plus 1/4 minus 0.0
Anchor bolt setting	plus 1/16 minus 1/16

030210 WATERSTOP - GENERAL

Waterstop shall be installed in concrete joints where indicated on the Plans and on the Typical Details. Waterstop shall be rubber or polyvinyl chloride.

Waterstops in the walls shall be carried into lower slabs and shall join the waterstops in the slabs with appropriate types of fittings. All vertical joints in waterbearing structures shall have waterstops, whether indicated on the Plans or not. All waterstops shall be continuous. Waterstops shall be set accurately to the position and line indicated on

the Plans. Edges shall be held and securely fixed in position at intervals of not more than 12 inches so that they will not move during the placing of concrete. No nails shall be driven through waterstops in the vicinity of construction joints. Wires at not more than 12 inches on centers near the outer bulbs shall be used to tie the waterstops into position. Special clips may be used in lieu of wires, at the Contractor's option. Waterstops shall be terminated 3 inches from the top of finished surfaces of walls and slabs unless otherwise specified or indicated on the Plans.

Waterstops shall be as manufactured by Burke Concrete Accessories Inc., Greenstreak Plastic Products Division of Western Textile Products Company, Kirkhill Rubber Company, Williams Products Inc., or equal.

Ribbed type waterstops will not be allowed.

030211 RUBBER WATERSTOP

Unless otherwise specified or indicated on the Plans or Typical Details, rubber waterstop shall be 6-inch flat dumbbell type, centered, at construction and contraction joints, and 9-inch wide dumbbell type with 1-inch diameter hollow center bulb, centered, at expansion joints. Rubber waterstop shall meet the following requirements:

		<u>Test Method</u>
Hardness - Shore A durometer 2240	60 to 70	A S T M D
Elongation - not less than	450 percent	ASTM D 412
Tensile strength - not less than	3,000 psi	ASTM D 412
300 percent modulus - not less than 1456	900 psi	A S T M D
Water absorption after two days at 158 degrees F	5 percent	ASTM D 471
Tensile strength after aging 48 hours in oxygen at 70 degrees C and 300 psi	80 percent of origin	ASTM D 572

		<u>Test Method</u>
Compression set, 22 hours at 158 degrees F	30 percent	ASTM D 395
Specific Gravity	1.17 plus or minus 0.03	

The Contractor shall submit samples, prints, and complete physical property data covering the waterstop.

Rubber waterstop shall be manufactured to insure an integral cross section which will be dense, homogeneous, and free from porosity and other

imperfections. Minor surface defects such as surface peel covering less than 1 square inch and surface cavities or bumps less than 1/4 inch in longest lateral dimension and less than 1/16 inch deep, will be acceptable.

All waterstops shall be installed so that all joints are watertight. All joints for rubber waterstops shall be made by the use of factory-made fittings and unions, some of which will be special. Fittings and unions shall be cemented in place using clamps over the entire area of splice until the cement is bonded permanently. Welding of the waterstop without the use of factory-made unions and fittings, will not be permitted. Split type waterstop will not be permitted.

Cement shall be as recommended by the manufacturer of the waterstop, and field cementing or solvent welding shall be in accordance with the manufacturer's printed directions.

030212 POLYVINYL CHLORIDE WATERSTOP

Unless otherwise specified or indicated on the Plans or Typical Details, polyvinyl chloride waterstop shall be 6-inch flat dumbbell type, centered, at construction and contraction joints, and 9-inch wide with 1-inch diameter hollow bulb dumbbell type, centered at expansion joints. The waterstop shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material.

The Contractor shall submit samples, prints, and complete physical property data covering the waterstop. The Contractor shall submit written certifications that all of the material supplied on this project meets or exceeds the physical property requirements of the current U.S. Army Corps of Engineers Specification No. CRD-C572 and shall submit laboratory test reports indicating that the average properties of all the materials and finished waterstops conform to the following:

		<u>Test Method</u>
Specific gravity - not less than	1.3	ASTM D 792
Type A Shore durometer hardness 2240	70 to 90	A S T M D
Tensile strength - not less than	2,000 psi	ASTM D 638
Ultimate elongation - not less than	350 percent	ASTM D 638
Alkali extraction, 7-day weight change between	minus 0.1 percent to plus 0.25 percent	CRD-C-572
Low temperature brittle point - not more than	minus 35 degrees F	ASTM D 746
Water absorption - 24 hours - not more than	0.1 percent	ASTM D 570
Accelerated extraction tensile - not less than	1,500 psi	ASTM D 412
Stiffness in flexure - not less than	750 psi	ASTM D 747
Tear resistance	300 lbs/in	ASTM D 624

Six-inch waterstop shall weigh not less than 130 pounds per 100 linear feet. Nine-inch waterstop shall weigh not less than 220 pounds per 100 linear feet. Thickness shall be 3/8-inch. Center bulb shall be 1-inch nominal outside diameter. Allowable tolerances are width plus or minus 3/16-inch; thickness plus or minus 1/32-inch.

Waterstop shall be installed so that all joints are watertight. All joints such as unions, crosses, ells and tees for polyvinyl chloride waterstop shall be field welded with thermostatically controlled equipment recommended by the waterstop manufacturer. The Contractor shall demonstrate the ability to weld acceptable joints in the polyvinyl chloride waterstop before installing waterstop in the forms. Quality of welded joints will be subject to the approval of the Engineer.

030220 PREFORMED EXPANSION JOINT MATERIAL

Preformed expansion joint material shall be sponge rubber or bituminous fiber types as specified herein. Specific type to be used in any application shall be as indicated on the Plans and on the Typical Details. The Contractor shall submit sufficient information on each type of material to the Engineer for review to determine conformance of the material to these Specifications.

Thicknesses and dimensions of the materials shall be as indicated on the Plans or as required according to the way it is used. Expansion joint strips shall be fastened to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

Sponge rubber expansion joint material shall be Cementone Code 3329 as manufactured by W. R. Grace and Company, neoprene sponge rubber expansion joint as manufactured by Burke Concrete Accessories Inc.; or equal.

Bituminous fiber expansion joint material shall be Cone Fiber Expansion Joint Fillers Code 1390 as manufactured by W. R. Grace and company, Burke Fiber Expansion Joint, or equal.

030221 SYNTHETIC SPONGE RUBBER FILLER

A. Synthetic sponge rubber filler shall be an expanded closed-cell sponge rubber backer rod manufactured from a synthetic polymer neoprene base; or a resilient closed-cell polyethylene foam backer rod. The synthetic sponge rubber filler shall have characteristics suitable for the application intended, including the following:

1. Necessary strength for supporting the sealing compound during application.
2. Sufficient resiliency to prevent significant load transfer across the joint.
3. Resistance to the environmental conditions of the installation.

4. No bonding to the sealing compound.
 5. A cellular structure that shall prevent wicking or absorption of water.
 6. Compatibility with other materials in the joint, and acceptance by the manufacturer of the sealing compound.
- B. The size of the synthetic sponge rubber filler shall be 25 percent greater than the nominal joint width.
- C. Acceptable products include No. 750.3 Ropax Rod Stock manufactured by the Presstite Division of Interchemical Corporation; Rubatex-Cord manufactured by the Rubatex Corporation; or equal.
- D. Surface preparation and installation of the synthetic sponge rubber filler shall be as recommended by the manufacturer in published instructions. The synthetic sponge rubber filler shall not be stretched beyond its normal length during installation.

030230 CAULKING, JOINTS, AND SEALING

Expansion, contraction, and construction joints shall be constructed as detailed on the Plans and Typical Details, and materials used shall be as specified herein. Pipe and conduit shall be installed in structures as detailed on the Plans and Typical Details, and shall be sealed with the materials specified herein. Doors, windows, louvers, and other items installed in or over concrete openings shall be caulked inside and out with the materials specified herein.

030231 CAULKING

All caulking where indicated on the Plans or as specified, except for masonry construction and where specified otherwise, shall be done with synthetic rubber sealing compound. Caulking shall be completed prior to painting.

Concrete must be thoroughly cured prior to caulking. All surfaces to be caulked shall be dry, clean, and free of dirt, grease, curing compounds, and other residue which might interfere with adhesion of the caulking compound. Concrete, masonry, wood, and steel surfaces shall be cleaned and primed in strict accordance with the manufacturer's recommendations prior to caulking. Sponge rubber filler materials may be used as backing for caulking, if acceptable to the Engineer. Filler material, when used, shall be compressible and untreated.

Caulking shall be applied with a pneumatic caulking gun. Nozzles of the proper shape and size shall be used for the application intended. A continuous bond shall be maintained between the caulking and the sides of the joint to eliminate gaps, bubbles, or voids and to fill the joint in a continuous operation without layering of the compound. All joints and seams shall be caulked by experienced applicators in a neat workmanlike manner.

No caulking shall be applied when the temperature exceeds 120 degrees F to avoid sponging or bubbling of compound. To hasten curing of the compound when used on wide joints subject to movement, the Contractor shall apply heat with infra-red lamps or other convenient means.

Excess caulking shall be removed by soaking and scrubbing before caulking has cured with Chem Seal CS9900; equivalent product of Products Research and Chemical Corporation; or equal. Excess cured material shall be removed by sanding with No. 80 grit sandpaper.

030232 SYNTHETIC RUBBER SEALING COMPOUND

Synthetic rubber sealing compound shall be a multi-part polyurethane designed for continuous submerged condition in water or sewage and exposed to direct sunlight in a dry condition. Synthetic rubber sealing compound shall be PRC 270 as manufactured by Products Research and Chemical Company, Elastothane 227R as manufactured by Pacific Polymers Inc., or equal. Sealing compound shall comply with Federal Specification TT-S-00227e, Type I (pourable grade) and Type II (nonsag), Class A, and the following requirements. Polyurethane sealant shall have the following properties determined at 75 degrees F and 50 percent relative humidity:

- Base - polyurethane rubber
- Solids - not less than 97 percent
- Application Time - not less than 2 hours
- Cure Time - not more than 3 days
- Tack Free Time - 24 hours
- Ultimate Hardness - 35 plus or minus 5 (Shore A)
- Tensile Strength (ASTM D 412) - 300 pounds per square inch minimum
- Ultimate Elongation - not less than 550 percent (ASTM D 412)
- Tear Resistance - not less than 85 pounds per inch (ASTM D 624 Die C)

Color shall be gray to match concrete, unless otherwise indicated, and the temperature service range shall be 50 degrees F to 200 degrees F.

Polyurethane sealant shall be a compound designed to cure at room temperature to a firm, highly resilient rubber.

All surfaces to which synthetic rubber must bond shall be dry and free of dust, dirt, and other foreign residue, rough sand blasted caulking groove to provide a sound surface, and shall be primed with the manufacturer's recommended primer for the particular surface.

Application shall be in strict accordance with the manufacturer's published instructions. Application shall be by means of a pneumatic caulking tool or other acceptable method.

All packages shall be code dated. No material shall be more than six months old when used. Material shall have been kept at temperatures lower than 80 degrees F at all times.

030250 EPOXY INJECTION SYSTEM

Where epoxy injection is required to repair cracks in concrete material, the application shall be subject to review and acceptance by the Engineer.

030251 EPOXY MATERIALS

All epoxy materials shall be new and shall be used within the shelf life limitations set forth by the manufacturer.

Epoxy shall be a two-part type low viscosity epoxy adhesive material containing 100 percent solids and shall meet or exceed the following characteristics when tested in accordance with the standards specified:

- A. ASTM D 638, Tensile Strength: 9,055 psi at 14 days and 77 degrees F cure.
- B. ASTM D 790, Flexure Strength: 12,000 psi at 14 days and 77 degrees F cure.
- C. ASTM D 695, Compressive Strength: 16,440 psi at 24 hours and 77 degrees F cure.
- D. Bond Strength: Concrete shall fail before failure of the epoxy.
- E. Gel Time In A 5-Mil Film: 4 hours maximum at 77 degrees F.
- F. ASTM D 638, Elongation: 1 percent minimum at 14 days and 77 degrees F.

For dry and damp concrete, the epoxy shall be Sikadur Hi-Mod LV as manufactured by the Sika Chemical Corporation; Adhesive Engineering Company Concessive No. 1380; or equal.

030252 METHOD OF INJECTION OF EPOXY

Adequate surface seal shall be applied to the crack or joint to prevent escape of the epoxy. Entry points shall be established at a distance along the seal not less than the thickness of the cracked member.

A 100 percent solid epoxy adhesive as specified above shall be forced into the crack at the first port with sufficient pressure to advance the epoxy to the adjacent port. The original port shall be sealed and entry shifted to the port at which the epoxy appears. This manner of port-to-port injection shall be continued until each joint has been injected for its entire length.

Before processing, the space in the vicinity of a crack location receiving epoxy shall have been swept and left in a generally clean condition. All joints receiving epoxy under this section shall be cleaned free from dirt, laitance, and other loose matter.

Pump unit used for injection shall be a positive displacement type with interlock to provide an in-line mixing and metering system for the two-component epoxy. The pressure hoses and injection nozzle shall be of such a design as to allow proper mixing of the two components of epoxy. The presence of a standby injection unit may be required.

For small amounts, or where excessive grout pressure developed by a pump unit might further damage the structure, premixed material and a hand caulking gun may be used if acceptable to the Engineer.

Seal all ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out. Any condition other than normal shall be reported to the Engineer. Solvents may not be used to thin the epoxy system introduced into the cracks or joints. All work under this Specification shall be performed and conducted in a neat orderly manner.

030270 EPOXY GEL

Epoxy gel shall be Sikadur Hi-Mod Gel manufactured by Sika Chemical Corporation; Concessive No. 1438 manufactured by Adhesive Engineering Company; or equal. Epoxy gel shall be used for vertical or overhead work, or where a high viscosity epoxy is required. Epoxy gel for vertical or overhead work may be used for horizontal work. All mixing, installing, and curing of epoxy shall conform to the manufacturer's published instructions.

030290 EXPANDED POLYSTYRENE

When expanded polystyrene joint filler is shown on the plans or specified, the filler shall be placed in correct position before concrete is placed against the filler. Holes and joints in the filler shall be filled with caulking to prevent the passage of mortar or concrete from one side of the joint to the other.

Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a flexural strength of 35 pounds per square inch, minimum, determined in accordance with ASTM Designation: C 203, and a compressive yield strength of between 16 and 40 pounds per square inch, at 5 percent compression. When shown on the Plans, surface of expanded polystyrene shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to Federal Specification LLL-B-810, any type. Other facing materials may be used provided they furnish equivalent protection. All boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

030300 REINFORCEMENT

All reinforcing steel shall be new material, of the quality specified, free from excessive rust or scale or any defects affecting its usefulness.

030310 REINFORCING BARS

Reinforcing bars to be embedded in concrete or masonry shall be Grade 60 deformed bars conforming to ASTM A 615 and shall include the supplementary requirements. No field bending of bars will be allowed. All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturer's guarantee of grade which will identify variations.

All bars shall be new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work. A thin coating of red rust resulting from short exposure will not be considered objectionable, but any bars having rust scale, loose mill scale, or a thick rust coat shall be thoroughly cleaned, or shall be rejected and removed from the premises upon order of the Engineer.

Bars shall be delivered bundled and tagged with identifying tags.

Bars shall be cut and bent in accordance with the provisions of ACI 315 and ACI 318. All bars shall be bent cold. Bars shall be free from defects and kinks and from bends not indicated on the Plans.

Reinforcing bars shall be welded where indicated on the Plans or acceptable to the Engineer. Welding shall be performed in accordance with AWS D1.4 "Structural Welding Code Reinforcing Steel."

Shop drawings on reinforcing steel detailed by the Contractor in accordance with the Contract Documents will not be reviewed and returned. The Contractor shall supply the Engineer with a copy of all reinforcing steel detail drawings. Changes to the Contract Documents made by the Contractor in reinforcing steel shop drawings shall be called out in the letter of submittal. Such changes will not be acceptable unless the Engineer has expressed consent to such changes in writing.

030311 PLACING BAR REINFORCEMENT

Reinforcing bars shall be accurately placed and adequately secured in position. Bars at splices shall overlap as specified or indicated on the Plans. If the lap splice length is not specified or indicated on the Plans, bars shall be lap spliced in accordance with ACI 318. Lap splices for masonry, if not specified or indicated on the Plans and not specified in DIVISION 4, shall be in accordance with the Uniform Building Code. Bar supports shall be galvanized steel, shall conform to ACI 315, and shall be furnished in sufficient number to prevent sagging and to support loads during construction, but in no case shall the quantities and locations of the supports be less than indicated in ACI 315. Bar supports, where used in slabs which will be exposed to view, shall be equipped with plastic tips. Reinforcing for concrete placed on the ground shall be supported by standard manufactured chairs, with steel plates for resting on the ground. No use shall be made of brick, broken concrete masonry units, spalls, rocks, or similar material for supporting reinforcing steel.

Unless otherwise indicated on the Plans, reinforcement shall be placed so as to provide the thickness of protective concrete covering as indicated on the Typical Details. If not indicated on the Plans or Typical Details protective covering shall be in accordance with ACI 318.

The Contractor shall submit to the Engineer for review and acceptance samples of all chairs he proposes to use along with a letter stating where each type chair will be used. No concrete shall be placed until this prior acceptance has been obtained.

030312 TYING BAR REINFORCEMENT

Bars shall be fastened securely in place with annealed steel wire ties. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (does not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity). Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections other than around the periphery shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	<u>Slab Bars,</u> inches	<u>Wall Bars,</u> inches
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 and No. 11	120	96

The above tying requirements do not apply to reinforcement for masonry. For masonry, vertical bars shall be held in position at top and bottom and at intervals not exceeding 192-bar diameters.

Where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a length equal to the lap splice length indicated on the Plans. Where the lap splice length is not indicated on the Plans, then the lap splice length shall be as specified in ACI 318 and this Division. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

The Plans and Typical Details contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

030320 WELDED WIRE FABRIC REINFORCEMENT

Welded steel wire fabric shall be welded wire fabric in accordance with ASTM A 185. It shall be of new stock, free from excessive rust when placed in the work. All necessary wiring, spacing chairs, or supports shall be installed to keep the welded wire fabric in place while concrete

is being placed. The welded wire fabric shall be bent as shown or required to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work. Welded wire fabric shall be lap spliced as indicated on the Plans. If the lap splice length is not indicated on the Plans, the welded wire fabric shall be spliced in accordance with ACI 318.

Welded wire fabric may be used in place of reinforcing steel bars if accepted by the Engineer. The welded wire fabric shall be furnished in flat sheet form. The cross-sectional area per linear foot of wire fabric shall be not less than the cross-sectional area per linear foot of reinforcing bars indicated on the Plans.

030400 MIXING CONCRETE

Mixing equipment shall be subject to review and acceptance by the Engineer. Mixers may be of the stationary plant, paver, or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material.

The mixing equipment shall be capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation.

Concrete mixing plant and equipment shall be maintained in good working order and shall be operated at the loads, speeds, and timing recommended by the manufacturer or as specified.

The cement and aggregate shall be proportioned by weight.

030410 MACHINE MIXING

The batch plant shall be capable of controlling the delivery of all material to within 1 percent by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale which will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and addition of mixing water will not be permitted. Retempering of concrete will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

Mixing shall be done in batch mixers of acceptable type. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed. Each

mixer shall be equipped with a device for automatically measuring, indicating, and controlling the time required for mixing. This device shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C 94. The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 90 minutes or shall the elapsed time at the jobsite exceed 30 minutes. Under conditions contributing to quick setting, the total elapsed time permitted may be reduced by the Engineer. Each truck mixer shall be equipped with a device for counting the number of revolutions of the drum which device shall be interlocked so as to prevent the discharge of concrete from the drum before the required number of turns. After the drum is once started, it shall be revolved continuously until it has completely discharged its batch. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions or to decrease the designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such increase or decrease.

In the case of other types of mixers, mixing shall be as follows. The concrete shall be mixed until there is uniform distribution of the materials, and the mixer shall be discharged completely before being recharged. Neither speed nor volume loading of the mixer shall exceed the manufacturer's recommendations. Mixing shall be continued for a minimum of 1-1/2 minutes after all materials are in the drum, and for batches larger than 1 cubic yard the minimum mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.

030420 HAND MIXED CONCRETE

Hand mixing of concrete shall be done only when requested by the Contractor in writing and accepted by the Engineer.

Hand mixed concrete shall be prepared on a watertight level platform in batches of not to exceed 1/3 cubic yard each. The required amount of coarse aggregate shall first be spread on the platform in an even and uniform layer, over which the proper proportion of fine aggregate shall then be likewise spread. The combined depth of both such layers shall not be greater than 1 foot. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch which shall thereafter be turned with shovels not less than three times before being removed from the platform.

030500 CONVEYING AND PLACING CONCRETE

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.

030510 CONVEYING CONCRETE

Equipment for chuting, pumping, and conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials. Chutes and devices for conveying and depositing concrete shall be so designed and used that the concrete shall be directed vertically downward when discharged from the chute or conveying device.

Chutes for conveying concrete shall be kept thoroughly cleaned by washing and scraping upon the completion of any day's placement.

030520 PLACING AND CONSOLIDATION

No concrete shall be placed without the prior authorization of the Engineer.

Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position and loose form ties at construction joints have been retightened, nor until all dowels, bucks, sleeves, hangers, pipes, conduits, bolts, and any other fixtures required to be embedded therein have been placed and adequately anchored, nor until the forms have been cleaned and oiled as specified.

Placement of concrete in which initial set has occurred or of retempered concrete will not be permitted.

No concrete shall be placed during rainstorms or high velocity winds. Concrete placed immediately before rain shall be protected to prevent the water from coming in contact with it or winds causing excessive drying. Sufficient protective covering shall be kept on hand at all times for protection purposes.

030521 PLACING CONCRETE

The Contractor shall prepare and submit to the Engineer for review, a proposed sequence of placing concrete showing proposed beginning and ending of individual placements. After acceptance, this sequence shall be adhered to except when specific changes are requested by the Contractor and accepted by the Engineer. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to place concrete in any portion of the work. This notification shall be such time in advance of the operation as the Engineer deems necessary for him to make final inspection of the preparations at the location of the proposed concrete placing. All forms, steel, screeds, anchors, ties, and inserts shall be in place before the Contractor's notification of readiness is given to the Engineer.

Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with the vibrator or otherwise. No concrete shall be dropped freely into place

from a greater height than 5 feet. Tremies shall be used for placing concrete where the drop is over 5 feet. Placement of concrete on slopes shall commence at the bottom of the slope.

Concrete shall be placed in approximately horizontal layers not to exceed 24 inches in depth and shall be brought up evenly in all parts of the forms. Concrete placement shall continue without avoidable interruption, in a continuous operation, until the end of the placement is reached. The placement of concrete in wall forms shall not proceed at a faster rate of rise than 6 feet per hour when the temperature is 70 degrees F or over, and at a lesser rate for lower temperatures.

If it takes more than 20 minutes lapse prior to placement of new concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20 minutes. If concrete is to be placed over previously placed concrete and more than 20 minutes have elapsed, then a layer of grout not less than 1/2 inch thick nor more than 1 inch in thickness shall be spread over the surface before placing the additional concrete.

The placement of concrete for slabs, beams, or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one hour.

030522 CONSOLIDATING CONCRETE

Concrete shall be placed with the aid of acceptable mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faces in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes, or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18 inches.

Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact, and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired in a manner acceptable to the Engineer.

030523 REQUIREMENTS DUE TO EXTREME WEATHER CONDITIONS

For concrete placed when the ambient air temperature is above 90 degrees F, the forms and reinforcing steel shall be cooled to below 90 degrees F by water spraying. The temperature of the concrete mix at time of placement shall be kept below 90 degrees F by means possible which do not impair the quality of the concrete.

The Contractor shall secure the Engineer's acceptance for type of equipment to be used for heating materials and/or new concrete in the process of curing during excessively cold weather.

For concrete placed below an ambient air temperature of 40 degrees F, or 45 degrees F and falling, provision shall be made for heating the water. If materials have been exposed to freezing temperatures to the degree that any material is below 35 degrees F, the material shall be heated. Water, cement, or aggregate materials shall not be heated in excess of 160 degrees F. Concrete in the forms shall be protected by means of covering with tarpaulins, or other acceptable covering, and a means shall be provided for circulating warm moist air around the forms to maintain a temperature of 50 degrees F for at least five days.

For conditions which promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind, the Contractor shall take corrective measures to minimize the rapid water loss from the concrete. The Contractor shall submit the corrective measures he plans to use for review and acceptance by the Engineer prior to placing concrete.

The Contractor shall provide and use a sufficient number of maximum and minimum self-recording thermometers to adequately indicate the temperature around the concrete.

030524 FOOTINGS AND SLABS ON GRADE

Concrete to be placed on ground or compacted fill shall not be placed until the subgrade is in a moist condition acceptable to the Engineer. If necessary, the subgrade shall be well sprinkled with water not less than 6 nor more than 20 hours in advance of placing concrete. If it becomes dry prior to the actual placing of concrete, it shall be sprinkled again, without forming pools of water. No concrete shall be placed if the subgrade is muddy or soft.

030525 REPAIR OF DEFECTIVE CONCRETE

All defective work shall be removed and replaced or repaired. Any work which has not been constructed in accordance with the Plans and Specifications shall be considered defective.

Correction of defective work shall be as specified herein. No defective work shall be patched, repaired, or covered without inspection by the Engineer. Repair shall have a strength equal or greater than the specified concrete for the area. The Contractor shall provide a mix

design for the grout which is proposed for use to the Engineer for review and acceptance. All imperfections in the work shall be chipped out and keyed ready for repair. The dry pack method shall be used for holes having a depth nearly equal to or greater than the least surface dimension of the hole, for cone-bolt, and narrow slots cut for repair. Smooth holes shall be roughened with a rotohammer before repair. The mortar method of replacement shall be used for holes too wide to dry pack and too shallow for concrete replacement and shall be used for comparatively shallow depressions, large or small, which extend no deeper than the reinforcement nearest the surface. Concrete replacement shall be used when holes extend entirely through the concrete section or when holes are more than 1 square foot in area and extend halfway through the section. All surfaces of the set concrete to be repaired shall first be coated with epoxy bonding agent, Adhesive Engineering Concessive No. 1001 LPL; Sika Chemical Corporation, Sikadur Hi-Mod; or equal. No repair shall be made until the Engineer has accepted the method of preparing the surface and proposed method of repair.

The color of the repair concrete dry pack and grout shall match that of the adjoining concrete. The use of white cement may be required to match color. The Contractor shall prepare test panels for proposed repairs at the beginning of the project for review and approval by the Engineer. This panel will serve as a standard for repairs during the project.

Curing of all repaired concrete shall be the same as specified for concrete.

030600 CURING CONCRETE - GENERAL

All concrete shall be cured by the methods specified herein.

All concrete shall be cured a minimum of seven days.

All concrete that is to be painted shall be water or plastic membrane cured. No curing compound shall be used on any concrete surface that is to receive paint or upon which any material is to be bonded. All other concrete shall be cured by water curing or sprayed curing membrane at the Contractor's option, except floors and slabs which are specified to be sealed with a concrete sealer. Floor slabs may be cured using a plastic film membrane curing.

030601 WATER CURING

All surfaces of concrete being water cured shall be kept constantly and visibly moist day and night for a period of not less than seven days and nights. Each day the forms remain in place may count as one day of water curing. No further curing credit will be allowed for forms in place after contact has once been broken between the concrete surface and the forms. Ties shall not be loosened during the period when concrete is being cured by leaving the forms in place. The top of walls shall be flooded with water at least three times per day, and the concrete surface shall be kept moist at all times during the seven-day curing period.

030602 SPRAYED MEMBRANE CURING

Membrane curing compound shall be a clear type with fugitive dye conforming to ASTM C 309, Type 1D.

The curing compound shall be applied to the concrete surface after repairing and patching, and within one hour after the forms are removed. If more than one hour elapses after the removal of the forms, membrane compound shall not be used and water curing shall be applied for the full curing period. If the surface requires repairing or painting, the concrete shall be water cured.

Curing compound shall not be removed from the concrete in less than seven days. Curing compound may be removed by the Contractor only upon written request by the Contractor and acceptance by the Engineer, stating what measures the Contractor shall take to adequately cure the structure.

Care shall be taken to apply curing compound in the area of construction joints to see that curing compound is placed within the construction joint silhouette. The curing compound placed within the construction joint silhouette shall be removed by sandblasting prior to placing any new concrete. The Contractor has the option of water curing the construction joint. Any curing compound shall be removed through heavy sandblasting of the joint.

Curing compound shall be applied by a mechanical, power operated spray and mechanical agitator that will uniformly mix all pigment and compound. The compound shall be applied in at least two coats. Each coat shall be applied in a direction opposite to the preceding coat. The compound shall be applied in sufficient quantity so that the surface will have a uniform appearance and will effectively and completely conceal all natural color of the concrete at the time of the spraying. The Contractor shall continue to coat and recoat the surface until the specified coverage is achieved and until a coating film remains on the surface of the concrete. The thickness and coverage of the compound shall be such that the film can be scraped from the surface at any and all points after drying for at least 24 hours.

The Contractor is cautioned that the method of applying curing compound specified herein may require more compound than normally suggested by the manufacturer of the compound and also more than is customary in the trade. The amounts specified herein shall be applied, regardless of manufacturer's recommendations or customary practice, if the Contractor elects to use curing compound in place of water curing.

If the Contractor desires to use a curing compound other than the specified compound, the Contractor shall coat sample areas of concrete wall with the proposed compound and also a similar adjacent area with the specified compound in the specified manner for comparison. Complete data on the proposed compound shall also be submitted for review. If the proposed sample is not equal or better, in the opinion of the Engineer, in all features, the proposed substitution will not be allowed.

Prior to final acceptance of the work, the Contractor shall remove, by sandblasting or other acceptable method, any curing compound on surfaces that will be exposed to view, so that only the natural color of the finished concrete will be visible uniformly over the entire surface.

030603 PLASTIC MEMBRANE CURING

Polyethelene film may be used to cure slabs, and shall be sealed at joints and edges with a small sand berm. The plastic membrane shall be installed as soon as the concrete is finished and can be walked on without damage. The concrete shall be kept moist under the plastic membrane.

030610.01. FINISHING

Concrete surfaces shall be finished as indicated on the Plans and Typical Details. Where not specified or indicated on the Plans, the surfaces shall be finished as follows:

Concrete surfaces which are specified or indicated to be painted, and all concrete surfaces, interior or exterior, exposed to view shall have fins removed and joints ground smooth, and shall be "sacked" with cement mortar so that all pits and holes are filled. Surfaces in open channels, basins, and similar structures, which are normally below the water surface shall have fins removed, but need not have joints ground. However, surfaces in such locations which are above the normal water surface and exposed to view shall have fins removed and joints ground smooth, and shall be "sacked" with cement mortar so that all pits and holes are filled. Concrete surfaces in closed boxes or channels where there is normally no access or passageway shall have the fins removed. All form ties shall be removed from all surfaces, and holes shall be filled after roughening with a rotohammer.

The following surfaces shall be troweled, then given a light hairbroom finish:

Exterior walkways

Tops of exterior walls or beams which are to serve as walkways
Tops of exterior walls or beams which are to support grating

The following surfaces shall be screeded off to grade and left rough:

Channel floors

Basin bottoms to which a 2-inch layer of grout is to be applied
Projecting footings which are to be covered with dirt
Slab surfaces which are to be covered with concrete fill

The following surfaces shall receive a smooth steel trowel finish:

Tops of corbels

Tops of walls and beams not covered above
Tops of all slabs not covered above herein
All other surfaces not specified to be finished otherwise

The final steel trowel finish shall be uniformly smooth and free of all irregularities. Building and machine room floors which are not to be covered with surfacing material shall be free from trowel marks. Trowel marks will be permitted in other locations. Concrete floor surfaces to which a surfacing material is to be applied shall be finished level and smooth with a tolerance of not over 1/8 inch in 10 feet in any direction.

Edges of all control joints shall be as indicated on the Plans and Typical Details. Edges shall include any line where placement is stopped. All wall and slab surfaces at edges shall be protected against concrete spatter and shall be thoroughly cleaned upon completion of each placement.

030700 CEMENT MORTAR AND GROUT

Cement mortar or grout for the repair of imperfect concrete work, filling of holes left by form bolts or ties, and the filling of voids around items through the concrete, and grout for spreading over construction joints and cold joints etc., shall consist of Portland cement and sand mixed in the same proportions used for the concrete being repaired, with only sufficient water to give the required consistency. Essentially, this would consist of the concrete mix with the coarse aggregate removed and water quantity required. In no case shall the water-cement ratio be more than that specified for the concrete being repaired. In the case of mortar being used for patching or repairing exposed concrete surfaces which are not to be painted or which will not be submerged in water, sufficient white cement shall be used to make the color of the finished patch match that of the surrounding concrete. Bolt and tie holes shall be roughened with a rotohammer filled with dry-pack mortar, well tamped into the holes. For dry-pack mortar, only enough water shall be used so that the resulting mortar will crumble to the touch after being "balled."

Concrete surfaces shall be roughened with a rotohammer, cleaned, and thoroughly damp before grout or mortar is placed, or, where indicated on the Plans or specified, an epoxy bonding agent, such as Concessive No. 1001 LPL as manufactured by Adhesive Engineering Company, Sikadur Hi-Mod as manufactured by the Sika Chemical Corporation, or equal, shall be applied to the clean, roughened, dry surface before placing the mortar or grout.

Grout for spreading over the surfaces of construction joints or cold joints shall consist of sand and cement with no more water used than allowed by the water-cement ratio specified for the concrete.

Particular care shall be exercised in placing cement mortar or grout since it will be expected to furnish structural strength or an impermeable water seal or both. Cement mortar or grout that has not been placed within 30 minutes after mixing shall not be used.

Grout for which the mix is not otherwise specified shall be mixed in the proportions by volume of one part cement to four parts of concrete sand.

030710 NONSHRINK GROUT

Nonshrink grout shall be made with a hydraulic cement, which when mixed with water will harden rapidly to produce a permanent high strength material suitable for exterior use. Nonshrink grout shall be nonmetallic and shall not contain calcium chloride or other chemicals which accelerate the corrosion of embedded steel. The grout shall show no shrinkage prior to initial setting in accordance with ASTM C 827 and shall show no shrinkage in the hardened state when tested in accordance with ASTM C 157 and Corps of Engineers CRD C-621. Nonshrink grout shall be Five Star Grout manufactured by U.S. Grout Corporation, Masterflow 713 Grout manufactured by Master Builders, or equal.

When mixed in accordance with manufacturer's published instructions, the nonshrink grout shall be semi-fluid and suitable for placing by pouring into place when mixed to a flowable consistency. The compressive strength tested in accordance with ASTM C 109 shall be not less than 3,000 psi at 1 day and not less than 6,000 psi at 28 days. Setting time tested in accordance with ASTM C 191 shall be not less than 30 minutes.

030720 EPOXY GROUT

Epoxy grout shall be used where specified herein or where shown on the Plans. Epoxy grout may be used to repair surface defects in concrete work.

Epoxy grout shall be made by mixing one part epoxy with not more than two parts sand. The sand shall be clean, bagged, graded, kiln dried silica sand. The prepared grout shall wet the contact surface and provide proper adhesion or a coat of epoxy shall be applied prior to placing the epoxy grout. Manufacturer's published instructions for mixing and application shall be followed.

For vertical or overhead work the epoxy shall be Sikadur Hi-Mod Gel, manufactured by Sika Chemical Corporation; Concessive No. 1438, manufactured by Adhesive Engineering Company; or equal. For horizontal work the epoxy shall be Sikadur Hi-Mod LV, manufactured by Sika Chemical Corporation; Concessive No. 1001 LPL, manufactured by Adhesive Engineering Company; or equal. Epoxy grout for vertical or overhead work may be used for horizontal work.

030800 SPECIAL CONCRETES

030811 CONDUIT ENCASEMENT

All concrete used for the encasement of electrical ducts, conduits, etc. shall be colored red by mixing into each cubic yard of concrete 10 pounds of red oxide No. 1117 as manufactured by the Frank D. Davis Company; equivalent product by I. Reiss Company, Inc.; or equal.

030880 SHOTCRETE

Shotcreting shall conform to all requirements of "Specification for Materials, Proportioning, and Application of Shotcrete (ACI 506.2)" published by the American Concrete Institute, Detroit Michigan, except as modified by the requirements of these Specifications.

Shotcrete may be of either the wet mix or dry mix type.

030881 SHOTCRETE SUPPLEMENTAL REQUIREMENTS

The supplemental requirements listed below are keyed to the article and paragraph numbers of the referenced ACI Shotcrete Specification.

- A. 1.6.3 Construction testing shall be by the test panel method in accordance with paragraph 1.6.3.2.
- B. 1.6.5 Preconstruction testing shall be required.
- C. 2.1 Cement shall be Portland cement conforming to ASTM C 150, Type II, low alkali.
- D. 2.2.1 Aggregate shall be normal weight conforming to Gradation No. 1 in Table 2.2.1.
- E. 2.4 Admixtures for wet mix shotcrete shall be as specified for concrete elsewhere in these Specifications.
- F. 2.5 Shotcrete shall have a 28-day compressive strength $f'c$ of 4,000 psi.
- G. 3.2 Formwork for shotcreting shall be as specified for concrete elsewhere in these Specifications. In addition, shotcrete forms must be adequately stiffened and supported to withstand the impact of shotcrete placement and must also permit the escape of air and rebound.
- H. 3.2.1 Surfaces to which shotcrete is to be applied shall be original undisturbed soil unless otherwise indicated on the Plans or permitted by the Engineer. Where backfill is permitted, it shall be ABC compacted to 95 percent maximum density placed in horizontal lifts and trimmed where necessary.
- I. 3.3.4 Reinforcement for shotcreting shall be as specified for concrete elsewhere in these Specifications. Where shotcrete is reinforced with welded wire mesh, the reinforcing fabric shall be kept within 1/2 inch of the center of the shotcrete coating.

- J. 3.3.5 The finished shotcrete maximum deviation of the shotcrete surface from true line and grade shall not exceed the tolerances listed. Deviation of the shotcrete surface from true line on side slopes shall not exceed a 1-inch offset from true line in 12 feet of run along the line. Deviation of the shotcrete surface from true line on horizontal surfaces shall not exceed a 1-inch deviation in 10 feet of run. All sloped surfaces shall be graded to drain.

<u>Item</u>	<u>Maximum Tolerance,</u> <u>inches</u>	
Reservoir side slopes	plus 1/2	minus 6
Ditch and reservoir bottoms	plus 1/2	minus 1/2
Ditch side slopes	plus 1/2	minus 1

- K. 3.5 Provide natural gun finish except where noted otherwise on the Plans.

- L. 3.6.2 Control joints shall be as indicated on the Plans.

- M. 3.7.5 Natural curing shall not be permitted.

Shotcrete shall be plus 1 inch or minus 1/4 inch of thickness values indicated on the Plans. Payment for shotcrete shall be included in the unit price paid for Item 1500-3, connection of 96-inch RGRCP at existing junction structure.

032000. MEASUREMENT

Payment for portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete and doing all work required to construct the structures in conformity with the Plans and Specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the Plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. However, all concrete shall be placed to line and grade within such tolerances as, in the opinion of the Engineer, are reasonable and acceptable for the type of work involved. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

The quantity of reinforcing steel, when scheduled as a separate item, will be calculated for payment on the basis of the number of each type bar actually placed in accordance with the Plans or with the instructions of the Engineer. The weight will be calculated using the theoretical lengths of bars placed and the unit weight per linear foot specified in ASTM A-305.

* * * END OF DIVISION 3 * * *

DIVISION 5

METALS

050100 STRUCTURAL AND MISCELLANEOUS METALS

050110. GENERAL

This part of the Specifications includes but is not limited to the following items:

- Aluminum and miscellaneous nonferrous metals
- Anchor bolts
- Bolts
- Grating and frames
- Manhole frames and covers
- Metal fasteners and welding
- Miscellaneous aluminum
- Miscellaneous cast iron
- Miscellaneous other metal items
- Miscellaneous structural steel

050120 MATERIALS

Unless otherwise specified or indicated on the Plans, structural and miscellaneous metals shall conform to the standards of the American Society for Testing and Materials (ASTM), including the following:

<u>Item</u>	<u>ASTM Standard No.</u>	<u>Class, Grade, Type or Alloy No.</u>
<u>Cast Iron</u>		
Cast Iron	A 48	Class 40B
<u>Steel</u>		
Galvanized sheet iron or steel	A 446 A 525 A 526	Coating G90
Black steel, sheet or strip	A 569 A 570	
Coil (plate)	A 635	

<u>Item</u>	<u>ASTM Standard No.</u>	<u>Class, Grade, Type or Alloy No.</u>
Structural plate, bars, rolled shapes, and miscellaneous items	A 36	
Standard bolts, nuts, and washers	A 307 A 325	
High strength bolts, nuts, and hardened flat washers	A 325 A 490	
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	
Tubing, hot-formed	A 501	
Steel pipe	A 53	Grade B
<u>Stainless steel</u>		
Plate, sheet and strip	A 167	Type 304 or 316
Bars and shapes	A 276	Type 304 or 316
<u>Aluminum</u>		
Sheet aluminum-flashing	B 209	Alloy 5005- H14, 0.032 inches min. thickness
Sheet aluminum-structural	B 209	Alloy 6061-T6
Structural aluminum	B 308 B 209	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42

Stainless steels are designated by type or series defined by AISI.

050130 FABRICATION AND ERECTION

Fabrication and erection of steel items shall conform to AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings wherever applicable, except as the same may be modified by applicable building codes and these Specifications. Where anchors, connections or other details of miscellaneous metalwork are not definitely indicated on the Plans, or specified in the Specifications, their material, size, form, attachment, and location shall be equivalent in quality and workmanship to items specified herein.

Galvanized structural steel or iron shall be hot-dip galvanized after fabrication in accordance with ASTM A 123. Electro-galvanizing shall not be used unless specified. Galvanized items that bend or twist during galvanizing shall be restraightened. Cut or otherwise damaged galvanized surfaces shall be field repaired to equivalent original condition using Galvinox, Galvo-Weld, or equal.

The Contractor shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and be responsible for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all metalwork in the field. Sharp or hazardous projections shall be rounded off and ground smooth. The Contractor shall paint steel and miscellaneous ferrous metal items in accordance with these Specifications.

Where aluminum comes in contact with dissimilar metals, except stainless steel, it shall be bolted with stainless steel bolts and separated or isolated from the dissimilar metals, with neoprene gaskets, sleeves, and washers. Those parts of aluminum which will be cast into concrete or which will be in contact with concrete, masonry, or wood shall be coated as specified elsewhere in these Specifications.

The threads of stainless steel bolts shall be coated, prior to installing the nut, with Never-Seez manufactured by Never Seez Compound Corporation; WLR No. 111 manufactured by Oil Research, Inc.; or equal.

050300 PAINTING METALS

050310 PAINTING ALUMINUM

Exposed aluminum surfaces shall not be painted. Markings shall be removed and surfaces left clean. Those parts of aluminum which will be cast into concrete shall be coated with not less than two coats of zinc chromate primer. Those parts of aluminum which will come in contact with masonry, concrete, or wood shall be coated with not less than two coats of Bitumastic Black Solution manufactured by Koppers Company, Inc; Tarmastic 100 manufactured by Porter Coatings; or equal.

050320 PAINTING FERROUS METALS

Ferrous metal items which are stainless steel, galvanized, or sherardized, unless otherwise specified, shall not be painted. Ferrous metal items that are built into concrete or masonry, except reinforcing steel, or are hidden from view in the finished job shall be given a prime coat only.

All other ferrous metal items, unless otherwise specified, shall be given a finish coating system of alkyd gloss enamel applied over a primer recommended by the manufacturer. The coating shall consist of not less than two coats of the specified finish coat over one coat of primer 3.0 mils dry film thickness to a total minimum dry film thickness for the system of 6 mils. Finish coats shall be Glid-Guard Alkyd Industrial Enamel No. 4550 Series manufactured by Glidden-Durkee Division of SCM

Corporation, Cleveland, Ohio; Industrial Enamel B-54 Series manufactured by The Sherwin-Williams Company, 101 Prospect Avenue N.W., Cleveland, Ohio; Tnemec-Gloss Series 2 manufactured by Tnemec Company, Inc., 123 West 23rd Avenue, North Kansas City, Missouri; or equal. Primer coat shall be from the same manufacturer as the finish coats, and unless otherwise recommended by the manufacturer shall be a long oil alkyd primer such as Glidden Glid-Guard Primer No. 4570; Sherwin-Williams Kromik Metal Primer E41-N1; Tnemec 99 Red Primer; or equal. Substrate surface shall be power tool cleaned to meet Steel Structures Painting Council SP-3 or better.

050500 METAL FASTENING

Unless otherwise indicated on the Plans or specified, metal fastening shall be as follows.

050510 BOLTING

- A. Bolts, except high strength bolts, shall be provided with flat washers and self-locking nuts, or lock washers and nuts.
 - 1. Bolt heads and nuts shall be hex-type.
 - 2. Bolts, nuts, and washers shall be of domestic manufacture.
- B. Bolts, including anchor bolts, nuts, washers, and similar fasteners specified to be galvanized, shall be galvanized in accordance with ASTM A 153.
- C. After installation, bolts, including anchor bolts and concrete anchors, shall project a minimum of two threads but not more than 1/2 inch beyond the nut.
- D. Unless otherwise specified, bolts, including anchor bolts and concrete anchors, shall be tightened to the snug-tight condition. The snug-tight condition shall be defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

050512 ASSEMBLY BOLTS

Bolts, nuts, and washers for wood baffles, collectors, and other field assembled construction shall be as follows:

- A. Type 316 stainless steel in wet and moist locations, including:
 - 1. For water containing structures,
 - a. Below and at water level.
 - b. Above water level,
 - 1) Below top of walls of water containing structures.
 - 2) Under the roof of enclosed water containing structures.

2. Dry side of walls of water containing structures.
 3. Pump bases.
- B. Type 304 or Type 316 stainless steel for aluminum assemblies.
- C. Hot-dip galvanized ASTM A 307 steel for galvanized assemblies and for applications other than those specified hereinbefore.

050520 FASTENERS FOR USE IN CONCRETE

Fasteners for use in concrete shall be as specified hereinafter. "Slug-in," lead cinch, and similar systems relying on the deformation of lead alloy or similar materials in order to develop holding power shall not be used.

050521 ANCHOR BOLTS

Anchor bolts shall be cast in place when concrete is placed, wherever feasible. Anchor bolts embedded in concrete shall be accurately located and with bolts perpendicular to the surface from which they project.

Anchor bolts, nuts, and washers shall be as follows:

- A. Type 316 stainless steel in wet and moist locations, including:
1. For water containing structures,
 - a. Below and at water level.
 - b. Above water level,
 - 1) Below top of walls of water containing structures.
 - 2) Under the roof of enclosed water containing structures.
 - c. Dry side of walls of water containing structures.
 - d. Pump bases.
- B. Type 316 stainless steel for fastening aluminum to concrete or steel.
- C. Stainless steel, hot-dip galvanized ASTM A 307 steel, or hot-dip galvanized ASTM A 36 steel, at the option of Contractor, for applications other than those specified hereinbefore.

Anchor bolts shall not touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, anchor bolts shall be insulated with not less than four wraps of 10-mil PVC tape in the area adjacent to the reinforcing steel.

In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut. Bolts, when indicated on the Plans for future use, shall be first coated thoroughly with nonoxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with a waterproof polyvinyl tape.

Anchor bolts shall be embedded not less than 10 diameters and shall have a standard hex bolt head or a 90-degree hook not less than 4 diameters in length. Where indicated on the Plans, anchor bolts shall be set in metal sleeves having an inside diameter approximately 2 inches greater than the bolt diameter and not less than 12-bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

050522. CONCRETE ANCHORS

Concrete anchors shall mean drilled in place anchors with integral threaded studs. Concrete anchors shall not be used in lieu of anchor bolts. Concrete anchors shall be manufactured by ITT-Phillips Red Head, "Wedge Anchors;" "Wej-It" Corporation, "Wej-It" concrete anchors; or equal.

The material of each concrete anchor, including its integral threaded stud, wedge washer, and nut, shall be Type 304 or Type 316 stainless steel.

Concrete anchors shall have the following minimum embedment lengths:

<u>Diameter</u> <u>Inches</u>	<u>Embedment Length</u> <u>Inches</u>
1/4	1-3/4
3/8	1-7/8
1/2	2-1/4
5/8	2-3/4
3/4	3-1/4

Anchor bolts may be cast in the concrete in lieu of using concrete anchors.

Concrete anchors shall be accurately located and set perpendicular to the surfaces from which they project.

050523 DEFORMED BAR ANCHORS

Deformed bar anchors shall be D2L Deformed Bar Anchors manufactured by Nelson Stud Welding Company; DA Deformed Anchors manufactured by Blue Arc; or equal. Deformed bar anchors shall conform to ASTM A 496.

The deformed bar anchors shall be butt welded with an automatic stud welding gun as recommended by the manufacturer. The weld shall develop the full strength of the anchor.

050524 STUDS

Headed studs shall be S3L Shear Connectors or H4L Concrete Anchors manufactured by Nelson Stud Welding Company; SC Shear Connector Stud or HA Headed Anchors manufactured by Blue Arc; or equal. Headed studs shall conform to ASTM A 108 and shall have a minimum yield strength of 50,000 pounds per square inch and a minimum tensile strength of 60,000 pounds per square inch.

The headed studs shall be butt welded with an automatic stud welding gun as recommended by the manufacturer. The weld shall develop the full strength of the stud.

050525 FLUSH SHELLS

Flush shells shall be used only where specifically indicated on the Plans. Flush shells shall be ITT-Phillips Red Head Multi-Set Drop-In Anchor; Hilti Corporation Hol-Hugger HDI Drop-In Anchor; or equal. Bolts, flush shells, threaded rods, washers, and nuts shall be Type 303 stainless steel. Flush shells shall be accurately located and set perpendicular to the surfaces from which they project.

050526 POWDER ACTUATED FASTENERS

Powder actuated fasteners for installation in concrete or steel shall be zinc coated heat-treated alloy steel. Fasteners not sufficiently protected against corrosion under the conditions to which they will be exposed, shall be coated as necessary to make them suitable for such conditions. Pins shall have a head or threaded stud capable of transmitting the loads that shanks are required to support. Pins connected to steel shall have longitudinal serrations around the circumference of the shank.

Use of powder actuated fasteners shall be limited to only the applications indicated on the Plans or specified in the Specifications.

050800 WELDING

Welding of structural metals shall be done by welders who have a current American Welding Society (AWS) certificate for the type of welding to be done by the welder. The Contractor shall notify the Engineer at least 24 hours before starting shop or field welding. The Engineer may check the materials, the equipment, and the qualifications of the welders. Welders doing unsatisfactory work shall be removed from the Work, or may be required to requalify.

The Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or any other aid to visual inspection which he may deem necessary on any part or all welds to examine the welds.

The cost of retests on defective welds shall be borne by the Contractor. Cost in connection with qualifying welders shall also be borne by the Contractor.

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Welds shall be full penetration welds unless otherwise indicated on the Plans.

050810 WELDING ALUMINUM

Welding of aluminum shall be in accordance with AWS D1.2, Structural Welding Code - Aluminum. Detail requirements for welding aluminum alloy 6061-T6 shall be as specified in the following paragraphs.

Filler metal for welding aluminum shall be aluminum alloys conforming to the requirements of AWS A5.10 and shall be AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 556.

Welding of structures which are to be anodized shall be done using filler alloys which will not discolor when anodized. ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556 filler alloys shall be used.

Dirt, grease, forming or machining lubricants, and organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding shall be performed when the inert gas tungsten arc welding method is used. This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is done with the automatic or semi-automatic inert gas shielded metal arc.

Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining, or shearing may be used.

Welding of aluminum shall be done using a nonconsumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used.

050830 WELDING STAINLESS STEEL

The general requirements of AWS D1.1, Structural Welding Code - Steel, shall apply to the welding of stainless steel. Welding of stainless steel shall be done with electrodes and techniques recommended in "Welded Austenitic Chromium - Nickel Stainless Steel - Techniques and Properties" distributed by the Nickel Development Institute, Toronto, Canada, and in accordance with AWS D10.4 Recommended Practice for Welding Austenitic Chromium - Nickel Stainless Steel Piping and Tubing.

050850 WELDING STEEL

Welding of steel shall conform to AWS D1.1 Structural Welding Code - Steel.

Welding of ASTM A 36 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe shall be with electrodes conforming to AWS A5.1 Specification for Carbon Steel Covered Arc Welding Electrodes, using E70XX

electrodes; AWS A5.17 Specifications for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding, using F7X-EXXX electrodes; or AWS A5.20 Specifications for Carbon Steel Electrodes for Flux Cored Arc Welding, using E7XT-X electrodes.

051000 STRUCTURAL METAL

Structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made; and where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.

Structural items shall be installed accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting the structure or equipment for which intended. Cocking out of alignment, redrilling, reshaping, or forcing to fit fabricated items will not be permitted. Contractor shall place anchor bolts or other anchoring devices accurately and shall make surfaces which bear against structural items smooth and true to level to preclude the necessity of springing, redrilling, or reshaping.

Structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced and kept braced until concrete, grout, or dry pack mortar has hardened for a period of not less than 48 hours.

The Contractor shall submit certified copies of mill tests or reports from a recognized commercial laboratory including chemical, tensile, and bending properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with the applicable ASTM Standards.

051100 STRUCTURAL ALUMINUM

The Contractor shall furnish and install structural aluminum items as indicated on the Plans and as specified. He shall provide supplementary parts necessary to complete each item even though such work is not definitely indicated on the Plans and specified in the Specifications. Their size, form, attachment, and location shall be such as to conform to the best of current practice.

Materials not otherwise specified shall conform to the applicable ASTM Standards.

051110 ALUMINUM LAYOUT

Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material.

A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be considered to be 0.000013 per degree F.

051120 CUTTING ALUMINUM

Material 1/2 inch thick or less may be sheared, sawed, or cut with a router. Material more than 1/2 inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Reentrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for bolts shall be not more than 1/16 inch larger than the nominal bolt diameter. Holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal.

051130 ALUMINUM FORMING AND ASSEMBLY

Structural material shall not be heated, with the following exceptions:

Aluminum material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending or welding. Such heating shall be done only when proper temperature controls and supervision are provided to ensure that the limitations on temperature and time are observed.

Chips lodged between contacting surfaces shall be removed before assembly.

051400 STRUCTURAL STEEL

Structural steel shall be delivered free from mill scale, rust, or pitting. Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting. Contractor shall provide supplementary parts required for a complete structural steel erection even where such supplementary parts and work are not specified in detail in the Specifications or indicated on the Plans.

055210 ALUMINUM HANDRAIL (NONWELDED PIPE)

Aluminum railings shall be Wesrail manufactured by Moultrie Manufacturing Company, Moultrie, Georgia; Connectorail manufactured by Julius Blum and Company, Inc., Carlstadt, New Jersey; C-V Rail manufactured by Craneveyor Corporation, South El Monte, California; Enerco Metals; or equal.

Rails, posts, and fitting-assembly spacers shall be formed from ASTM B 429, 6063-T5 or T6, minimum Schedule 40, extruded aluminum pipe of not less than 1.89-inch OD and 0.14-inch wall thickness. Alloy 6063-T6 may be used for pieces requiring bending only. Kick plates shall be fabricated of aluminum alloy 6061-T6. Other aluminum parts shall be 6063

extruded aluminum, or F214 or F514.0 aluminum castings. Fabrications shall be made from ASTM B 209 or ASTM B 221 extruded bars. Bases shall be 6061 or 6063 extruded aluminum alloy. Other parts shall be Type 300 series stainless steel. The components shall be completely fabricated and assembled without welding. Plug screws or blind rivets shall be Type 305 stainless steel. Epoxy bonding of parts is not acceptable.

Aluminum railing components shall be given a Class I architectural 0.7-mil anodized finish on exposed surfaces after cutting. Aluminum shall be pretreated before anodizing for cleaning and removing markings. Finish shall conform to Aluminum Association Specification M32-C22-A41, mechanical finish-medium satin, chemical finish-medium matte, anodic coating-clear Class I architectural. Anodizing finish shall be clear.

The Contractor shall furnish and install handrails where indicated on the Plans and according to recommendations of the manufacturer except that pipe rails shall be fastened to fittings with Series 300 stainless steel pop rivets or flush set screws. He shall be responsible for the workmanship, rigidity, and protection of finish of the installation. Handrail shall be discontinued at lighting fixtures.

Pipe cuts shall be square and accurate for minimum joint-gap. Cuts shall be clean and straight, free of burrs and nicks. Holes shall be drilled and countersunk the proper size, as required for a tight, flush fit of assembly screws and other component parts. Where protection is applied for prevention of dissimilar materials electrolysis, none of the protective material shall be visible when assembly is completed.

Post spacing shall not exceed 6 feet. Other attachment brackets shall be spaced as specified on the manufacturer's installation drawings. A 1/8-inch diameter weep hole shall be provided at the base of each post to permit drainage of condensation. Posts shall be a single unspliced pipe length. Lower rails shall be a single, unspliced length between posts or continuous. Top rails shall be continuous whenever possible, and a single, unspliced length shall always be attached to a minimum of three posts, except that adequate provision shall be made for expansion and contraction of both top and bottom rails to satisfy local conditions. Fastenings and fasteners shall be as recommended or furnished by the manufacturer, and drawn up tight with a hand wrench or screw driver so that the completed railing shall be rigid and free of play at joints and attachments.

The Contractor shall protect the handrailing finish from scratches, gauges, dents, stains, and other damage. Damaged or disfigured handrailing shall be replaced with new handrailing.

During construction, the handrailing exterior surfaces shall be covered with a 0.4-mil, minimum, heat shrink polyethylene film. The film shall not be removed before the handrailing has been approved by the Engineer nor before the work of other trades in the proximity of the handrailing has been completed.

Shortly before final acceptance of the Work, and after removal of the polyethylene film, the Contractor shall cleanse the handrailing with a mild detergent or with soap and water. After cleansing, the Contractor shall thoroughly rinse the handrailing and wipe it dry with a soft cloth.

055230 STAINLESS STEEL PIPE HANDRAILS

Stainless steel handrails shall be of the prefabricated, shop assembled type, field welded type, or mechanically joined type. Stainless steel pipe handrails shall be supplied by R & B Wagner, Inc., Milwaukee, Wisconsin; Julius Blum and Company, Carlstadt, New Jersey; or equal.

Handrail posts, rails, brackets, and accessory parts shall be made of Type 304 or Type 316 stainless steel. Railings and posts shall be formed from 1-1/2-inch nominal, Schedule 5 pipe with minimum 1.900-inch OD and 0.065-inch wall thickness. Stainless steel shall have a No. 4 NAAMM finish.

Railings and posts shall be in the same plane. Handrail sections between splices shall not exceed 20 feet. Bends in pipe shall be made without the use of fittings where practical, and shall be formed with internal mandrels on power benders. Where the handrail is of the welded type, intersections and joints shall be made with continuous 360-degree welds. Welds shall be ground smooth. Where the handrail is of the mechanically joined type, joints shall be mechanical connections utilizing stainless steel machine screws with lock washers and threaded tubular rivets.

Post spacing shall not exceed 8 feet on center. Posts shall be grouted into core drilled holes or stainless steel pipe sleeves, or shall be bracket mounted to the face of concrete surfaces, as indicated on the Plans. Post insert reinforcing of 1.750-inch outside diameter, 0.083-inch wall thickness, and 26-inch length, shall be provided for all posts. Fasteners, connection plates, splice bars, and fittings shall be Type 304 or Type 316 stainless steel.

The Contractor shall protect the handrailing finish from scratches, gouges, dents, stains, and other damage. Damaged or disfigured handrailing shall be replaced with new handrailing.

During construction, the handrailing exterior surfaces shall be covered with a 0.4-mil, minimum, heat shrink polyethylene film. The film shall not be removed before the handrailing has been approved by the Engineer nor before the work of other trades in the proximity of the handrailing has been completed.

Shortly before final acceptance of the Work, and after removal of the polyethylene film, the Contractor shall cleanse the handrailing with a mild detergent or with soap and water. After cleansing, the Contractor shall thoroughly rinse the handrailing and wipe it dry with a soft cloth.

055300 GRATINGS

Except as otherwise specified or indicated on the Plans, grating shall be aluminum grating. Surfaces of shelf angles, rebates, and anchors in contact with concrete shall be coated in accordance with these Specifications.

Grating shall cover the areas indicated on the Plans. Unless otherwise indicated on the Plans, a grating over an opening shall cover the entire opening. The top surfaces of grating sections adjacent to each other shall be in the same plane.

Aluminum plate or angles shall be installed where required to fill openings at changes in elevation and at openings between equipment and grating. Angle stops shall be installed at ends of grating. Once installed, grating shall not slide out of the rebate or off the support. Stops shall be welded in place unless otherwise specified or indicated on the Plans.

There shall be not more than 1/8-inch clearance between the ends of the grating and the inside face of the vertical leg of the shelf angles. The horizontal bearing leg of the shelf angle shall not be less than 2 inches. Ends of grating and cutouts shall be banded. The width of the end band of the grating shall be 1/4 inch less than the depth of the grating with the top of the grating and the top edge of the banding flush. The width of cutout banding shall be full-depth of grating.

Cutouts in the grating shall be provided where required for equipment access or protrusion, including valve operators or stems, and gate frames. Edges of cutouts shall be banded with aluminum material similar to end banding.

Panel layout shall provide for installation and subsequent removal of grating around protrusions or piping. For openings 6 inches and larger grating panels shall be layed out so that the edges of two adjacent panels shall be on the center line of the opening. For openings smaller than 6 inches, the opening shall be at the edge of a single panel.

Where an area requires more than one grating section to cover the area, adjacent grating sections shall be clamped together at the 1/4 points with acceptable fasteners.

The Contractor shall submit calculations from the grating manufacturer showing that the grating will meet the load-bearing and deflection provisions of the Specifications for each size of grating and for each span. The Contractor shall, if requested by the Engineer, test under full load one section of each size of grating for each span length involved on the job, to show compliance with these Specifications. A suitable dial gauge shall be provided by the Contractor for measuring deflections. Grating shall be fabricated in units which do not exceed 50 pounds each.

055320. ALUMINUM GRATING

Aluminum grating shall be supported on aluminum shelf angles.

Gratings, shelf angles, and anchors shall be of 6061-T6 or 6063-T6 aluminum alloy, except that cross bars may be of 6063-T5 aluminum alloy.

Aluminum grating shall be of such bar size and spacing that, as determined by the manufacturer, the grating shall support a uniform live load of 180 pounds per square foot on the entire area of the grating, using an extreme fiber stress of not more than 18,000 pounds per square inch, and that the maximum deflection under this loading shall not be more than 1/240 of the clear span of the grating. The spacing of the main grating bars shall not be more than 1-1/8 inches clear between bars. Minimum depth of grating shall be 1-1/4 inches.

Grating shall be grooved Galok Aluminum I-Bar manufactured by IKG Borden Industries, Nashville, Tennessee; grooved I-Bar manufactured by Seidelhuber Metal Products, Inc., San Carlos, California; or equal.

056000 MISCELLANEOUS METAL

056100 MISCELLANEOUS ALUMINUM

Structural and other metal items fabricated from aluminum; not covered separately herein shall be fabricated in accordance with the best practices of the trade and shall be field assembled by riveting or bolting with no welding or flame cutting permitted.

056200 MISCELLANEOUS CAST IRON

Castings shall be tough, gray iron, free from cracks, holes, swells, and cold shuts. The quality shall be such that a blow from a hammer will produce an indentation on a rectangular edge of the casting without flaking the metal. Before leaving the foundry, castings shall be thoroughly cleaned and shall receive a 16-mil dry film thickness (DFT) coating of coal-tar epoxy unless otherwise specified in the Specifications or indicated on the Plans.

056210 MANHOLE FRAMES AND COVERS

Manhole frames and covers shall be gray iron castings, conforming to the requirements of ASTM A 48, Class 30-B. Frames and covers shall have horizontal and vertical bearing surfaces machined to fit neatly, and the cover shall bear firmly in the frame without rocking and shall be easily removable. Frames and covers shall be heavy duty traffic type and shall have a combined set weight of not less than 265 pounds. Frames and covers shall be delivered to the site unpainted.

Unless otherwise indicated on the Plans, frames shall have a clear inside opening of 24 inches diameter and shall be of the bottom flange type. Frame height shall be approximately 4-1/2 inches and bottom flange outside diameter shall be approximately 32 inches.

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Covers shall have a skid-resistant grid pattern design and shall be stamped with the name of the utility service provided by the manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "WATER." Covers shall be solid type without ventilation holes.

Manhole covers shall be set flush with paving. If no paving exists, the cast iron manhole cover shall be set 6 inches above the surrounding grade.

056400 MISCELLANEOUS STRUCTURAL STEEL

Miscellaneous steel items not specified herein shall be as indicated on the Plans or specified elsewhere in these Specifications and shall be fabricated and installed in accordance with the best practices of the trade.

058000. PAYMENT

Unless otherwise provided in the proposal, the basis of payment for steel structures shall be as follows:

The price paid for miscellaneous steel shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing, fabricating, delivering, erecting and prime coating the steel work including structural and cast steel construction, and steel fasteners, complete in place, as shown on the Plans, and as specified in these Specifications and the Special Provisions, and as directed by the Engineer.

The price paid for miscellaneous aluminum shall include full compensation for miscellaneous aluminum furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and placing the materials, complete in place, as shown on the Plans, and as specified in these Specifications and the Special Provisions, and as directed by the Engineer.

Full compensation for furnishing and placing sheet piling, preformed fabric pads, elastomeric or elastic bearing pads, and red lead paste, and for grouting masonry or bearing plates as shown on the Plans shall be considered as included in the price paid for miscellaneous steel and no separate payment will be made therefore. Where the Specifications or Plans require metal to be galvanized, the price paid for the metal, including the weight of zinc coating, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing the galvanized metal complete in place, as shown on the Plans, and as specified in the Specifications and the Special Provisions, and as directed by the Engineer.

Structural and miscellaneous steel shall be included in the lump sum bid for Item 515-1, Miscellaneous Steel. Structural and Miscellaneous Aluminum shall be included in the lump sum bid for Item 520-1, Miscellaneous Aluminum.

* * * END OF DIVISION 5 * * *

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DIVISION 15

PIPING, VALVES, GATES, AND SPECIALTIES

150000. GENERAL

Piping shall be installed as indicated on the Plans. The Contractor shall submit to the Engineer, for review and acceptance, his detailed proposed piping layouts.

Any pipe which does not meet specifications or has been rejected, shall be removed from the jobsite and disposed of by the Contractor at no extra cost to the Owner.

Where new fittings are to be cut into or attached to existing piping or where connections are to be made to existing piping, the Contractor shall furnish and install the necessary sleeves, flanges, nipples, couplings, fittings, or other devices needed to accomplish the cutting-in or connections, whether indicated on the Plans or not.

Lines under low head shall be laid flat or with a continuous grade so that there will be no air traps or humps in them, except at the ends where means for venting shall be provided.

In no case shall copper or copper alloy pipe or fittings carrying water or water based solutions or slurries be attached to cast-iron or steel pipe except by means of a dielectric coupling expressly made for this purpose and service.

All pipe which will operate under pressure shall be properly blocked at all fittings where the pipeline changes direction, changes size, or ends, using concrete thrust blocks in trenches and suitable anchors in structures. Concrete thrust blocks shall be sized so as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing an earth bearing of 200 pounds per square foot per foot of depth below natural grade. (Earth bearing value may be increased, if substantiated by soils analysis.) The line pressure shall be the product of the nominal cross sectional area of the pipe and the test pressures as specified for each type of pipe. The concrete shall be placed, unless indicated otherwise on the Plans, so that the pipe joints and fittings will be accessible.

150011. WALL AND SLAB PENETRATIONS

Unless indicated otherwise on the Plans, no pipe shall pass through or be built into any reinforced masonry or concrete wall, floor, ceiling, roof, pilaster, column, pier, or beam, unless it is inside of a sleeve; and such sleeves shall have an inside diameter not less than the outside diameter of the pipe plus 2 inches, except that for pipe smaller than 2 inches the ID of the sleeve shall be not less than twice the OD of the pipe. Such sleeves shall be placed not closer than three diameters center to center,

nor shall they impair the strength of construction. The arrangement of sleeves shall be such that pipe can be pulled out of a sleeve and replaced without disturbing the structural member. Ends of sleeves shall be flush with surfaces of concrete, masonry, or plaster.

150020. BURIED PIPING

All pipelines laid in open trenches shall conform to MAG Uniform Standard Specifications, Section 601.

Gravity pipelines shall be laid to the lines and grades indicated on the Plans, and shall be laid upgrade. Where not otherwise indicated on the Plans, all buried lines shall be laid with a minimum of 3-foot cover without air traps or humps. Where two lines of similar service run parallel to each other, they may be laid in the same trench as close together as possible and still provide adequate room for jointing and compaction of bedding material.

Before excavation is started for any run of underground piping, the Contractor shall locate and expose all existing structures, piping, conduit, etc., which intersect the line of the piping, to avoid possible damage to these during excavation operations and so that it may be determined if there will be any conflicts in location. In the event of conflicts in location or grade or both, between new piping and existing piping, the Contractor shall make adjustments in location or grade of new piping acceptable to the Engineer.

Unless otherwise indicated on the Plans or specified, where pipe of any type is to be encased in concrete, the encasement shall provide a minimum of 6 inches of concrete completely around the pipe, shall fill the bottom of the trench from bank to bank, if not formed, and shall be reinforced with four continuous longitudinal reinforcing bars, one in each corner of the encasement. Concrete shall be Class C. The length of encasement indicated on the Plans, or specified, shall be the minimum length, and the encasement shall terminate at each end at a joint in the pipe. Reinforcing bars shall be No. 4 for encasement of pipe 36 inches and smaller and No. 6 for encasement of pipe larger than 36 inches.

Where buried ductile iron, reinforced concrete, asbestos cement, vitrified clay, or similar rigid pipe enters a structure, it shall be by means of a coupling or wall piece cast into the wall, having a mechanical push-on, or similar flexible joint as specified or indicated on the Plans at the outside face of the wall. An additional similar joint shall be installed in the line at the edge of the structure excavation where the pipe trench leaves undisturbed ground. For steel pipe a single joint may be used located not more than 2 feet from the outside face of the wall.

At the close of the day's work, and at such other times when the pipe is not being laid, all openings in the end of the pipeline shall be closed with an accepted plug.

150021. LAYING OF PIPE AND FITTINGS

In laying pipelines, the deflection in a standard joint shall not exceed the manufacturer's recommendation. Horizontal and vertical deflections of not more than the recommended combined angle, including curves as indicated on the Plans, shall be made by deflections in standard pipe joints within 10 feet of the indicated stations. Five degree beveled joints may be used. Deflections of more than 5 degrees shall require special bends or fittings. Departure from and return to established alignment and grade shall not exceed 1/16 inch per linear foot of pipe and at no point shall the maximum departure from established line and grade be greater than 1 inch.

The laying of all pipe shall be in finished trenches free from water or debris. The joining of pipe sections shall be such as to produce water-tight lines. Pipe shall be laid on an unyielding foundation with uniform bearing under the full length of the barrel. If the pipe bears top or bottom markings, it shall be placed with the markings in the proper position. All adjustments to line and grade shall be made by scraping away or filling in under the pipe. Pipe shall not be dropped or pounded to fit grade. If the joints are the type which require external grouting, banding, or pointing, space shall be provided under and immediately in front of the bell end of each section laid of such shape and size as to permit sufficient room for the grouting, banding, or pointing of the joints.

Each section of pipe shall be lowered into the trench, utilizing a sling or other device, in a manner that shall prevent injury to the pipe, coating, lining, or joints. Under ordinary conditions of laying, the work shall be so scheduled that the bell end of the pipe faces in the direction of laying. In placing pipe in the trench, the pipe shall be held by the lowering device at the balancing point of the section. It shall not be dragged on the bottom of the trench but shall be supported while being fitted into the adjacent section. Supporting the pipe on blocks, or blocking of any nature, either temporary or otherwise, will not be allowed.

It is the responsibility of the Contractor, when the pipeline and appurtenances are finally laid, to see that all joints are protected and that any damage to the coating or lining of the pipe and fittings has been adequately repaired or replaced in order to preserve their integrity for corrosion protection.

150022. JOINTING OF RUBBER GASKETED PIPE

Unless specified otherwise under a particular type of pipe, the jointing of pipe with rubber gaskets shall be in accordance with the manufacturer's published instructions and this section.

The ends of the pipe shall be thoroughly cleaned with wire brushes or the equivalent to remove all foreign materials, including sealing compound, if any, from surfaces which are to be incorporated in the joint. The spigot recess, the rubber gasket, and the bell shall be lubricated with a soft,

vegetable compound. After lubrication, the gasket shall be thoroughly stretched when placing in the spigot groove so that there is a uniform volume of rubber distributed around the circumference. The gasket shall not be twisted, rolled, cut, crimped or otherwise injured or forced out of position during closure of the joint. Prior to assembling the joint in position, metal or wooden spacers shall be placed against the inside shoulder of the bell to provide the proper space for mortar between abutting ends of the pipe. After the joint is assembled, a "feeler" gauge shall be inserted between the bell and the spigot and the position of the rubber gasket checked around the complete circumference of the pipe. If the gasket is not in the proper position, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe relaid, and the gasket again checked.

Where indicated on the Plans and at locations where make-up field joints are required, the pipe shall be joined by lap welded field joints. Welded field joints at locations where a bell end is not provided shall be made by means of a bell end formed by a 4-inch butt strap welded to one side of the joint prior to assembly. All welding of field joints shall be in accordance with the requirement of AWWA Specification C 206.

After the pipe has been laid, and before trench backfill may commence, the outside annular space between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of the joint shall be completely protected with cement grout. Grout used for filling the outside joints by the pouring method shall be mixed in proportions of one part cement by weight, to not more than one part, by weight, of sand passing a No. 16 mesh screen and thoroughly mixed with water to the consistency of rich cream. A band of canvas or polyethylene shall be placed around the outside of the pipe and centered over the joint. The joint band shall be bound to the pipe by use of steel box strapping. The band shall completely and snugly encase the joint except for an opening at the top through which to pour the grout. The outside grout space, prior to filling with grout, shall be flushed with water so that the surfaces of the joint to be in contact with the grout filling will be thoroughly moistened when the grout is poured. Fluid grout shall be poured in only one opening in this joint and pouring shall be continuous until grout appears at the other side. The grout shall be rodded on both sides of the pipe to settle the grout and more grout added, as necessary, to fill the joint completely. Exposed portions of the joint, after filling, shall be covered with wet burlap. Joint bands shall not be removed.

Backfilling shall not be started until the exterior joint protection grout has set (2 hours) and the Inspector has checked and accepted each joint as completed.

After trench backfill is complete, the interior joint recesses shall be filled with mortar, tamped into the joint with a thin block of wood or other suitable tool, and pointed. The finished joint shall be smooth and flush with the adjacent pipe surfaces. Mortar for the inside of pipe

joints shall be mixed in the proportion of one part, by weight, of cement, to two parts, by weight, of clean well-graded sand, and just sufficient water shall be used so that the resulting mortar will crumble to the touch after being "balled".

All mortar or grout shall be newly mixed. No mortar or grout that has begun to set shall be used, and no retempering will be allowed.

150022.10 CURING AND PROTECTION OF JOINTS

Joints requiring mortar or grout shall be cured and protected as follows: Immediately after each exterior joint is completed, if not already by canvas or polyethylene band, it shall be protected from the sun by means of a covering of wet burlap and an initial covering of fine, moist earth or sand approximately 6 inches above the top of the pipe. Extreme care shall be taken in placing such earth around the pipe to avoid injury to freshly applied mortar or grout. At the close of the day's work and at such other times when the pipe is not being laid, if the inside joints are pointed, all openings in ends of the pipeline shall be covered by sacks and moist earth or sand to prevent drying out of the joint mortar by the circulation of air within the pipe.

150023 STEEL SURFACES EXPOSED TO WATER OR EARTH

All steel surfaces exposed to water or earth, including but not limited to blind flanges used in access manholes, construction manholes, bell rings at structures, all cast-iron or steel nuts and bolts, and dead ends shall be painted with an epoxy polyamide system of 10 mils dry film thickness conforming to the requirements of the FDA, Section 175.300 for potable water. The epoxy polyamide system used shall be as manufactured by Glidden, Tnemec, or equal, applied in accordance with the paint manufacturer's recommendations, to a clean surface, free of dust, dirt, mill scale, rust, oil, or grease, commercial blasted cleaned in accordance with SP-6, Steel Structures Painting Council Specifications.

150027. LAYING OF PVC PIPE OR CPVC PIPE

Trenching and backfill shall be in accordance with MAG Uniform Standard Specifications, Section 601.

The handling, storage, bedding, and installation of PVC pipe shall be in accordance with the manufacturer's recommendations and ASTM D 2774.

150030. CLEANING AND TESTING

The interior of all pipelines, above or below grade, shall be thoroughly cleaned of all adhering matter and other debris. No testing of any pipeline shall be started until the cleaning is complete and accepted by the Engineer.

Special precautions required in the cleaning of a particular pipeline shall be as stated in the various parts of this Division of these Specifications.

All pipelines, above or below grade, shall be tested to the pressures indicated in the various parts of this Division of these Specifications. Any piping for which test pressure is not specified shall be tested under a pressure of 25 psi above the operating head. New PVC waterline shall be pressure tested to 125 psi. RCP pipe shall be leak-tested only.

Pipe underground may be tested before backfilling unless otherwise specified, and pipes to be encased in concrete or under concrete slabs shall be tested before the encasement or slabs are placed.

The Contractor shall furnish all necessary personnel, supplies, equipment, bulkheads, and whatever additional equipment is required to make any and all tests specified and shall make any and all repairs, including relaying, if necessary, to any and all pipelines failing to pass the testing requirements of these Specifications.

The Contractor shall give the Engineer a list of the scheduled pipeline tests by noon of the day preceding the scheduled test or tests. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to test a line or portion of line. All bulkheads, thrust blocks, anchors, temporary connections, pumps, etc., shall be in place before the Contractor's notification of readiness is given to the Engineer. After testing, all pipes shall be flushed or blown out and left clean.

In testing with water, the test pressure specified shall be the pressure at the lowest point in the piping concerned. In testing with water, the lines shall be examined and any visible leaks repaired. In testing with air, the lines shall be examined and tested with soap suds and any leaks repaired. Testing shall be repeated until the lines are in satisfactory condition.

Despite any previous testing, any leaks developing before the end of the one year guarantee period shall be repaired by the Contractor at no additional expense to the Owner.

150036. POTABLE WATERLINES

Potable water pipelines shall be disinfected in accordance with MAG Uniform Standard Specifications, Section 611.

150070 CONNECTION TO IN-SERVICE LINES

Existing pipe to which connections are to be made shall be exposed by the Contractor to permit field changes in line, grade, or fittings, if necessary.

All connections to existing lines shall be constructed according to the Plans.

When shutdown of an in-service line is necessary in order to connect to the new lines, a conference between the Contractor's representative, the

Engineer, and operating supervisory personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary, shutdowns may be scheduled during other than normal working hours, at no additional cost to the Owner.

151400. REINFORCED CONCRETE PIPE

Where reinforced concrete pipe is indicated on the Plans, it shall be in accordance with ASTM C 76 with Class as noted on the Plans. Cement used in the manufacture of pipe shall be in accordance with ASTM C 150, Type II, low alkali. At least two 3-edge bearing tests shall be made on each size and class of pipe. No hydrostatic nor absorption tests will be required except as stated hereinafter.

151410 JOINTS

Joints shall be the rubber gasket type with the gaskets in accordance with ASTM C 361. Connections of reinforced concrete pipe to plant structures shall be with steel manufacturer's bell ring as detailed on the Plans. Plastic or fiberglass bell rings or collars shall not be used. Rubber gaskets shall be of the O ring type. The spigot shall be formed with a groove for the gasket.

151420 FITTINGS

Fittings required as indicated on the Plans shall be constructed to the standards of the pipe manufacturer. Details of fittings shall be submitted for Engineer's acceptance before fabrication.

151430 CURVES

In general, horizontal or vertical curves shall be made by using pipe with beveled ends or by slight deflections in the joints of straight pipe. If necessary, short length pipe shall be made for curves of shorter radius than can be made with beveled pipe of usual length. Detailed layouts of curves shall be submitted to the Engineer by the pipe manufacturer for review and acceptance before fabrication of the beveled pipe. Curves may be made by use of angle bands at joints in lieu of beveled ends. Not more than 15 degrees of deflection angle shall be made in any one joint. Each angle joint shall fall upon the curve of the radius as indicated on the Plans.

151440 PIPE DELIVERY AND HANDLING

All pipe shall be manufactured, handled, loaded, and shipped in such a manner as to be delivered undamaged, in sound condition, and conforming in all respects to these Specifications. Each section of pipe shall be plainly marked with the date of manufacture, D load, and top of pipe. Markings shall be scratched into the green concrete at both ends inside the pipe and shall be marked also on the outside of the pipe at the four quarter points.

151450 TESTING

After installation, all pipelines shall be left thoroughly clean. The lines shall be tested before complete backfilling by bulkheading the lower end of the pipe, filling the pipe gradually with water until there is a head of 2 feet more than the highest expected operating head. Each joint shall then be visually inspected and any leaks permanently repaired. Moist or sweating surfaces will not be deemed as leaks. If necessary, the pipe shall be overhauled, relaid, or collared with concrete until the joints hold satisfactorily. The Contractor shall furnish all necessary tools, labor, materials, water, bulkheads, and appliances needed for the test. Backfill at joints shall not extend above spring line before testing.

151800 PLASTIC PIPE, TUBING, AND FITTINGS

Except as otherwise specified herein, or indicated on the Plans, plastic pipe, tubing, and fittings shall be as follows.

Extruding and molding material shall be virgin material containing no scrap, regrind, or rework material except that, where permitted in the referenced standard specifications, clean rework material generated from the manufacturer's own operations may be used as long as the end product meets the requirements of this Specification. Pipe and tubing, except for drainage pipe, shall meet the requirements of the National Sanitation Foundation Testing Laboratories Inc. and shall bear the "nSf" seal.

All plastic pipe delivered to the jobsite shall be plainly marked as to nominal pipe or tubing size, type, class, schedule or pressure rating, and manufacturer.

Fittings shall be of the same material as the pipe and of equal or greater pressure rating, except that drainage waste and vent (DWV) fittings need not be pressure rated; and all fittings shall conform to the appropriate ASTM Specification. In general, fittings for rigid pipe shall be socket type for solvent or fusion welding, and fittings for nonrigid pipe shall be insert or flare fittings as specified or acceptable to the Engineer.

Transitions from plastic to metal or IPS pipe shall be by molded transition fittings, not by threading the plastic pipe. Unions 2-1/2 inches and smaller shall be socket end screwed unions, and unions 3 inches and over shall be made up of socket flanges with 1/8-inch full face soft rubber gasket. Unions shall be located where indicated on the Plans and elsewhere as directed by the Engineer for adequate access to the piping system for inspection and cleaning.

Nipples for transition from plastic pipe to rubber hose shall be serrated.

151810. POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PVC pipe shall be Schedule 40 PVC 1120, conforming to the requirements of ASTM D 1785 and appendices thereto. Pipe shall be extruded from Type I, Grade 1, Class 12454 material as specified in ASTM D 1784.

Fittings shall conform to ASTM D 2466 or D 2467 for pressure fittings, or to ASTM D 2665 for DWV fittings as is appropriate to the service and pressure requirement. Solvent for solvent welded fittings shall conform to ASTM D 2564.

151820. CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

CPVC pipe shall be Schedule 40 conforming to ASTM F 441, CPVC 4120, conforming to the requirements of ASTM D 1785 and appendices thereto. Pipe shall be extruded from Type IV, Grade 1, Class 23447 material as specified in ASTM D 1784.

Fittings shall conform to ASTM F 438 or F 439 for pressure fittings, as is appropriate to the service and pressure requirement. Solvent for solvent welded fittings shall conform to ASTM F 493.

152100 PIPING SPECIALTIES

The Contractor shall furnish and install, wherever shown on the Plans, as called for in these Specifications, or as required for proper operation of equipment, all items specified under this heading including gaskets, bolts, calking materials, hangers, supports, guides, anchors, and such incidental materials and equipment as are required to make the items complete and ready for use.

DIVISION 16

ELECTRICAL

160100 GENERAL

It is the intent of this part of the Contract Documents to cover all work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified.

160101. GENERAL PROVISIONS

Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.

All work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.

Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for a decision.

The alignment of equipment, conduit, duct bank and manholes shall be varied due to on-site changes, or to avoid work of other in-ground utilities or trades, without extra expense to the Owner.

The Contractor shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.

All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

The Contractor shall lay out and install electrical work prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.

The Contractor shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, etc. are improperly placed or installed, the Contractor shall do all necessary work, at his own expense, to rectify the errors.

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The Contractor shall submit shop drawings, data and details to the Engineer on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.

160102. WORK INCLUDED

Install a new electrical duct bank and abandon the existing electrical duct bank shown on the Plans. Remove or abandon portions of duct bank and cables and conductors as shown or required for new construction. Abandonment of existing electrical facilities shall be included under Item 1600-1, Relocate Existing Electric. Removal of miscellaneous abandoned concrete duct bank, as required for new construction, is a non-pay item.

All new wiring and spliced connections shall be tested as specified herein. Blockouts shall be installed in each pullbox or manhole as shown on the Plans.

When the new duct bank is complete, a duct bank transition into the existing manhole is complete, and the replacement circuit conductors are installed, arrange an outage period with the Owner, in accordance with the provisions of these Contract Documents. The outage period may require work to be performed during off-peak hours, as determined by the City, additional manpower or equipment, and shall be included in the project cost.

160103 REGULATIONS AND CODES

Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), National Electrical Safety Code (NEC), State and local codes, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Cable Engineers Association (ICEA); National Electrical Manufacturers Association (NEMA) Standards; National Electrical Contractors Association (NECA) Standard of Installation; and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). When applicable, the material used in the performance of the electrical work shall be approved by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

160105. TEMPORARY POWER

The Contractor shall furnish, install and maintain all temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. All connections shall be watertight with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove all temporary power and lighting systems equipment and devices.

160106 CUTTING AND REPAIRING

Where it becomes necessary to cut into existing work for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.

The Contractor shall repair all damage caused thereby and restore damaged areas to original condition.

160107. CORROSION PROTECTION

Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals as required with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

Factory finishes damaged and/or rusting shall be restored to original new condition.

160109. TEST

The electrical work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices.

160110 CONFORMS TO RECORD DOCUMENTS DRAWINGS

Prior to completion of the Contract, the Contractor shall furnish the Engineer with a set of electrical plans marked with any changes, deviations or additions to any part of the electrical work.

Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record documents drawings to enable rapid and accurate circuit tracing by maintenance personnel.

160111. SINGLE LINE DIAGRAMS

Single line diagrams, where indicated on the Plans, show circuit voltages, (4xx is 480V, 3xx is 277V, 2xx is 240V, 1xx is 120V circuits), wire and conduit sizes, circuit protection rating, and other pertinent data. Where conflicts exist on the Plans the single line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

160112. CIRCUIT IDENTIFICATION

The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C and shall match the existing color code and phasing method. The neutral shall be white.

In addition to color coding all conductors, each conductor shall be identified in each junction box, pull box, manhole, panelboard, cable tray, or termination cabinet with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal. Identification shall match existing wire marker indents, or, if none exist, shall consist of circuit number or tag number.

Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.

160116 CONDUCTOR FASTENERS

Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

160200 GENERAL MATERIALS AND METHODS

160201. GENERAL

All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacture, and of highest grade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

Field verification of scale dimensions on Plans is directed since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.

160202 RACEWAYS

Raceways include rigid metal conduit, rigid nonmetallic conduit, or any other channel for holding wires, cables, or bus bars that is designed for, and used solely for, this purpose.

160202.10 CONDUIT

160202.11. GENERAL

All conduit shall be rigid steel unless specifically indicated otherwise on the Plans. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than one inch.

Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.

Conduits entering or exiting concrete shall be PVC coated or equivalent.

Conduit runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends or with fittings of the conduit type. Conduit type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers.

Conduit runs shall not interfere with the proper and safe operation of equipment and shall not block or interfere with ingress or egress, including equipment removal hatches.

Exposed conduits shall be securely fastened with regulation clamps or straps. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit and motors or control equipment. The maximum length of flexible conduit shall be 5 feet. Where flexible conduit is used, it shall be grounding type, weatherproof and watertight as manufactured by American Brass Company, General Electric, or equal. All conduits located outdoors or in wet locations shall be weathertight.

Conduit runs on water-bearing walls shall be supported one inch away from the wall on an accepted channel. When channel galvanizing or other coating is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

Underground conduit runs shall be concrete encased, as detailed on the Plans, unless otherwise noted.

All conduit shall be thoroughly reamed after the threads have been cut to remove burrs. All joints shall be made with acceptable sealing compound and shall be watertight. Bushings or conduit fittings shall be used at all conduit terminals. The total of all bends in any run between pull boxes or junction boxes shall not exceed 360 degrees. Pull boxes shall be installed at points acceptable to the Engineer. Conduits brought into pull boxes, conduits, and other openings shall be capped until used to prevent the entrance of moisture. All spare conduits shall be capped and shall contain a suitable plastic pulling tape.

Joints shall be set up tight. Hangers and fastenings shall be secure and of a type appropriate in design and dimensions for the particular application.

After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be incorporated as part of the contract.

Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects or obstructions remain in the conduit prior to pulling in conductors.

Couplings, connectors, and fittings shall be threaded and shall be certified types specifically designed and manufactured for the purpose. They shall be installed expertly to provide a firm mechanical assembly and electrical conductivity throughout.

Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction. Expansion fittings shall be OZ type AX with jumper for exposed locations and type DX at structural expansion joints, Spring City, or equal.

Shop drawings shall be submitted as requested by the Engineer for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit.

160202.12. RIGID STEEL

Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate as manufactured by Triangle PWC, Inc., Allied Tube & Conduit Corporation, or equal.

Steel conduit shall not be buried in earth without concrete encasement.

160202.16 RIGID NONMETALLIC - PVC

Where specifically indicated on the Plans, or elsewhere specified, conduit may be high density Schedule 40, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested. Encasement shall be reinforced as indicated on the Plans. Conduit supports shall be installed at 2-1/2 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

160202.30 METAL PULL BOXES

160202.31. GENERAL

Furnish and install pull boxes as indicated on the Plans and specified herein. Unless specified otherwise, pull boxes shall be NEMA 4 rated.

Installation of pull boxes shall be such that access to the pull boxes is not restricted by obstructions such as pipes, valves, ladders, etc. Exact locations and sizes shall be submitted to the Engineer for review and acceptance prior to fabrication and installation.

Additional pull boxes shall be installed as required to meet cable manufacturer's pulling tension requirements.

Covers shall be secured with 316 stainless steel screws or bolts with coated threads.

160202.32 CONSTRUCTION

Pull boxes shall be compatible with the type of conduit systems on which they are used. Pull boxes shall be fabricated from 11-gauge (minimum) steel or aluminum and shall be completely weatherproof with gasketed removable covers. Weatherproof conduit hubs shall be furnished for all conduit connections to pull boxes.

160202.33. FINISH

All metal surfaces shall be phosphatized and primed with a rust-resistant paint. Finish shall be two coats of enamel paint.

160202.35 SIZING

Pull boxes shall be sized according to code and shall be sized to provide room for the future conduits and cables indicated on the Plans.

160202.40 MANHOLES

The Contractor shall furnish and install manholes where indicated on the Plans and as necessary to complete the underground distribution system. Manholes shall be sized to facilitate the duct banks. Manholes, manhole accessories, and covers shall, as minimum requirements, comply with the National Electrical Safety Code, ANSI C2.

Manholes, duct bank concrete, and raceways shall have no water leaks into the manhole interior. Manholes, duct bank concrete, or raceways which leak water into the interior during construction or the warranty period shall be replaced with new raceways and manholes. This paragraph applies to duct banks and raceways into structures - manholes, vaults, basements, tunnels, crawl spaces, and the like.

Sump pump pits shall be provided in each manhole. The pit shall be of sufficient size to accommodate a sump pump, however, the minimum size shall be 16" x 16" x 16".

Each manhole shall be provided with pulling eyes on each interior wall. The pulling eyes shall be secured to the structural steel.

Noncorrosive cable racks shall be provided to assure that each conductor is supported at 2-foot intervals. Conductors shall be supported, routed, and tied to preclude damage during personnel ingress.

160202.41 MANHOLE COVERS

Manhole covers shall be of cast iron, frame and inner pan for traffic loading and for electrical installations. The inner pan shall be made with caulking joint. Clear opening shall be 30 inches. The cover shall

have radial block tread, lifting ring and shall be machined to fit. The covers shall be as manufactured by Alhambra Foundry, or equal.

160203 CONDUCTORS

160203.01. GENERAL

All wiring shall be as indicated on the Plans. Wires shall be newly manufactured (not more than 12 months old) and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

Wire sizes shall be American Wire Gauge sizes with Class B or Class C stranded construction.

No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

As far as practicable, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit.

160203.02 PULLING LUBRICANT

All cables shall be properly coated with pulling compound recommended by the cable manufacturer before being pulled into conduits so as to prevent mechanical damage to the cables during installation.

Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

160203.20. 600 VOLT CLASS CABLE

Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have Type THWN insulation. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Plans. Panel control wiring shall not be less than No. 14 AWG. Wire and cable shall be as manufactured by Okonite Company, Anaconda Wire and Cable Company, or equal.

The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded. Conductors in duct banks shall be cable instrumentation.

160203.21. TERMINATIONS AND SPLICES (600 VOLT AND LESS)

Terminations shall be terminal board type with set-screw pressure connectors. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be waterproof heat shrink type as manufactured by Elastimold, Thomas-Betts, or equal.

160204. GROUNDING

The grounding systems shall consist of concrete encased ground conductors and/or ground rods. Each duct bank shall contain a concrete encased system ground conductor. The system ground conductors shall run continuously in duct banks, through manholes, handholes, and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous ground system. Each metallic raceway, electrical panel or enclosure, and other metallic devices associated with the electrical and instrumentation systems shall be bonded to this grounding system.

Verify that all existing equipment is grounded upon completion of electrical service installation.

All equipment cases, devices, etc. shall be grounded. Ground rods shall be driven or concrete encased conductors installed before a building or structure is built and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure where switchgear, motor control centers, switchboards, panelboards, etc. are installed.

Where ground conductors are not sized, the NEC shall govern. Driven ground rods shall be copperweld, or equal, 5/8-inch in diameter and not less than 10 feet in length.

All connections of ground cable to rods or to cable shall be thermoweld connections. Maximum allowable ground resistance shall be 5 ohms.

Tests shall be conducted by the Contractor and witnessed by the Engineer to determine the ground resistance for the entire system and at each building where there is switchgear, motor control, etc.

It is the intent of these Contract Documents that a grounding conductor for all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the power source ground, such as a motor control center or transformer system ground. All wireways, enclosures, etc. shall be properly bonded and grounded, and grounding conductors shall be run for all circuits.

160205 OUTLET, SWITCH, PULL AND JUNCTION BOXES

160205.01 GENERAL

Unless otherwise specified or indicated on the Plans, device boxes, condulets and junction boxes shall be heavy-duty cast and shall be compatible with the location and conduit system being used, rigid steel or rigid copper free aluminum and shall be as manufactured by Crouse-Hinds, Appleton, or equal, with stainless steel cover screws and with cover gaskets. Device boxes shall be FD type.

160205.10. FASTENERS

Fasteners used with wiring devices shall be stainless steel and all screws, nuts, bolts, etc. shall be stainless steel.

160205.20. CONCRETE PULL BOXES

The Contractor shall furnish and install precast concrete pull boxes in the locations indicated on the Plans and as required.

The pull boxes shall be installed on 12 inches of compacted gravel and shall be installed in such a manner that the cover of the pull box will be flush with finished grade.

The pull boxes shall be designed for traffic conditions, and the pull box and cover shall be designed for heavy traffic bridge loading. The pull boxes shall be a minimum of 3' x 4' x 4' deep with 3/4 inch diameter pulling irons located at each end. The pull boxes shall be constructed of reinforced Class A concrete.

The pull boxes shall be Quickset, Utility Vault Co., or equal, with covers. The covers shall be engraved "ELECTRICAL".

160212 ENCLOSURES

160212.01 GENERAL

This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 4 for outdoor installations.

160212.10 CONSTRUCTION - STEEL

Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.

A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.

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160212.11 FINISH - STEEL

Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

160218 TERMINAL BLOCKS

Terminal blocks shall be Square D Co., Buchanan, or equal. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

169000. PAYMENT

Payment for work under this section will be made at the lump sum bid for Item 1600-1, Relocate Existing Electric, or the unit price per linear foot bid for Item 1600-2, Concrete Duct Bank, installed complete including pulling wire and cable, and testing. Payment for electrical manholes and pullboxes, installed complete shall be at the unit sum bid for Item 1600-3. Item 1600-1 shall include all labor, materials, tools and coordination required to install new buried conduit, abandon existing electrical conduit or duct bank, make splices, reconnect existing equipment, test, reground, and make all existing equipment operational.

All concrete, reinforcing steel, conduits, grounding wire and special backfill required for installation of concrete duct bank according to plans and specifications shall be included under Item 1600-2. All concrete, reinforcing steel, special backfill, and miscellaneous items required for installation of concrete manholes and pull boxes according to Plans and Specifications, shall be included under Item 1600-3.

* * * END OF DIVISION 16 * * *