SCHEME B-SEQUENCE OF OPERATION

-LEAD AND SUBSEQUENT FUELING PUMPS STARTED AND STOPPED AUTOMATICALLY

SYSTEM IN "REFUELING" MODE
IDLE CONDITION

THE SCHEME B SYSTEM IS INTENDED TO REMAIN CONTINUOUSLY PRESSURIZED WHILE IN THE IDLE CONDITION. THIS ALLOWS THE SYSTEM TO RESPOND AUTOMATICALLY/IMMEDIATELY TO AIRCRAFT REFUELING MISSION REQUIREMENTS.

PERIODICALLY, WHILE IN THE IDLE CONDITION WITH NO AIRCRAFT REFUELING DEMANDS, THE SYSTEM WILL LOSE MINIMUM PRESSURE REQUIREMENTS. WHEN THIS OCCURS, THE CONTROL SYSTEM WILL AUTOMATICALLY RE-PRESSURIZE IN THE FOLLOWING SEQUENCE:

1. AS SYSTEM PRESSURE AT PRESSURE INDICATING TRANSMITTER PIT-1 OR PIT-2 (DEPENDING ON MICROPROCESSOR SELECTION) DROPS BELOW SET POINT OF 60 PSIG, THE CONTROL SYSTEM WILL START THE SELECTED LEAD FUELING PUMP, AND CONTROL SIGNALS WILL BE INITIATED FOR THE FOLLOWING FUNCTIONS:
   -THE BACK PRESSURE CONTROL VALVE (BPCV) SOLENOID "A" WILL BE ENERGIZED TO ENABLE BPCV TO MODULATE OPEN AT ITS SET POINT.
   -THE PRESSURE CONTROL VALVE (PCV) SOLENOID WILL BE ENERGIZED TO HOLD PCV CLOSED WHILE ANY PUMP IS RUNNING.
2. THE LEAD FUELING PUMP WILL ESTABLISH A FLOW OF 600+/- GPM THRU THE SYSTEM ISSUE VENTURI, AND THE PRESSURE UPSTREAM OF THE BPCV WILL INCREASE UNTIL THE BPCV SET POINT OF 80 PSIG (AS DETERMINED BY HYDRAULICS OF THE SYSTEM) IS REACHED. AT THIS PRESSURE, THE BPCV WILL START TO OPEN AND THE VALVE WILL MODULATE AS REQUIRED TO MAINTAIN PRESSURE UPSTREAM OF THE VALVE.
3. WITH NO FUELING DEMAND, THE RETURN VENTURI WILL SEE TOTAL FLOW OF 600 +/- GPM FROM THE LEAD PUMP. IF DPT-3H OR DPT-4H (DEPENDING ON MICROPROCESSOR SELECTION) SENSES DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE GREATER THAN 560 GPM FOR A PERIOD OF 60 SECONDS, THE CONTROL SYSTEM WILL INITIATE CONTROL SIGNALS FOR THE FOLLOWING FUNCTIONS:
   -THE SOLENOID "A" WILL BE DE-ENERGIZED (PRIOR TO LEAD PUMP SHUT-OFF) TO CLOSE THE BPCV. SIGNAL TO STOP LEAD PUMP SHALL OCCUR WHEN PRESSURE INDICATING TRANSMITTER PIT-1 OR PIT-2 (DEPENDING ON MICROPROCESSOR SELECTION) RISES ABOVE SET POINT OF 175 PSIG (AS DETERMINED BY HYDRAULICS OF THE SYSTEM).
   -THE PCV SOLENOID WILL BE DE-ENERGIZED (SIMULTANEOUSLY WITH SIGNAL TO STOP LEAD PUMP) TO BLEED SYSTEM PRESSURE TO 75 PSIG.

AT THIS POINT THE SYSTEM HAS RETURNED TO A PRESSURIZED IDLE CONDITION.

SYSTEM IN "REFUELING" MODE
REFUELING CONDITION

TO INITIATE AN AIRCRAFT REFUELING OPERATION, AN OPERATOR CONNECTS PANTOGRAPH EQUIPMENT TO AN AIRCRAFT. REFUELING CONTROL VALVES HAVE HYDRAULIC LINE PRESSURE "DEADMAN" CONTROL SYSTEMS. WHEN THE OPERATOR OPENS THE REFUELING CONTROL VALVE BY USE OF THE DEADMAN, THE FOLLOWING SEQUENCE OCCURS:

1. AS SYSTEM PRESSURE AT PRESSURE INDICATING TRANSMITTER PIT-1 OR PIT-2 (DEPENDING ON MICROPROCESSOR SELECTION) DROPS BELOW SET POINT OF 60 DUE TO DEPRESSING OF THE "DEADMAN" CONTROL, CONTROL SIGNALS WILL BE INITIATED FOR THE FOLLOWING FUNCTIONS:
   -THE BACK PRESSURE CONTROL VALVE (BPCV) SOLENOID "A" WILL BE ENERGIZED TO ENABLE BPCV TO MODULATE OPEN TO ITS SET POINT.
   -THE PRESSURE CONTROL VALVE (PCV) WILL BE ENERGIZED TO HOLD THE PCV CLOSED WHILE ANY PUMP IS RUNNING.
2. THE LEAD FUELING PUMP WILL ESTABLISH A FLOW OF 600+/- GPM THROUGH THE SYSTEM ISSUE VENTURI AND THE PRESSURE UPSTREAM OF THE BPCV WILL INCREASE UNTIL THE BPCV SET POINT OF 80 PSIG (AS DETERMINED BY HYDRAULICS OF THE SYSTEM) IS REACHED. AT THIS PRESSURE, THE BPCV WILL START TO OPEN AND THE VALVE WILL MODULATE AS REQUIRED TO PASS SUFFICIENT FLOW THROUGH THE RETURN VENTURI TO MAINTAIN PRESSURE UPSTREAM OF THE VALVE.
3. WITH DPT-1 OR DPT-2 (DEPENDING ON MICROPROCESSOR SELECTION) SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE OF 600+/- GPM THROUGH THE ISSUE VENTURI AND DPT-3L AND DPT-3H OR DPT-4L AND DPT-4H (DEPENDING ON MICROPROCESSOR SELECTION) SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE THROUGH THE RETURN VENTURI OF GREATER THAN 40+/- GPM AND LESS THAN 560+/- GPM, THE LEAD FUELING PUMP WILL CONTINUE TO RUN AND THE BPCV WILL CONTINUE MODULATING TO PASS FLOW AS NECESSARY TO MAINTAIN UPSTREAM PRESSURE REQUIREMENT AND NO ADDITIONAL CONTROL FUNCTIONS WILL BE INITIATED UNTIL SYSTEM OPERATING CONDITIONS CHANGE.

A. IF DPT-3H OR DPT-4H SENSES A DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE THRU THE RETURN VENTURI OF GREATER THAN 560+/- GPM FOR 60 SECONDS, THE CONTROL SYSTEM WILL INITIATE CONTROL SIGNALS FOR THE FOLLOWING FUNCTIONS:
   -THE BPCV SOLENOID "A" WILL BE DE-ENERGIZED TO CLOSE THE BPCV. SIGNAL TO STOP LEAD PUMP SHALL OCCUR WHEN PRESSURE INDICATING TRANSMITTER PIT-1 OR PIT-2 (DEPENDING ON MICROPROCESSOR SELECTION) RISES ABOVE SET POINT OF 175 PSIG (AS DETERMINED BY HYDRAULICS OF THE SYSTEM).
   -THE PCV SOLENOID WILL BE DE-ENERGIZED (SIMULTANEOUSLY WITH SIGNAL TO STOP LEAD PUMP) TO BLEED SYSTEM PRESSURE TO 75 PSIG.

4. WITH DPT-1 OR DPT-2 SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE OF 600+/- GPM THROUGH THE ISSUE VENTURI AND DPT-3L OR DPT-4L SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE OF LESS THAN 40+/- GPM THROUGH THE RETURN VENTURI FOR A PERIOD OF 10 SECONDS, A SECOND PUMP WILL BE STARTED.
5. WITH DPT-1 OR DPT-2 SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE OF 1200+/- GPM THROUGH THE ISSUE VENTURI AND DPT-3L AND DPT-3H OR DPT-4L AND DPT-4H SENSING DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE GREATER THAN 40+/- GPM BUT LESS THAN 700+/- GPM, THE LEAD FUELING PUMP AND SECOND FUELING PUMP WILL CONTINUE TO RUN AND THE BPCV WILL CONTINUE MODULATING TO PASS FLOW AS NECESSARY TO MAINTAIN UPSTREAM PRESSURE REQUIREMENT AND NO ADDITIONAL CONTROL FUNCTIONS WILL BE INITIATED UNTIL SYSTEM OPERATING CONDITIONS CHANGE.
   A. IF DPT-3H OR DPT-4H SENSES A DIFFERENTIAL PRESSURE CORRESPONDING TO A FLOW RATE THROUGH THE RETURN VENTURI OF GREATER THAN 700+/- GPM FOR 15 SECONDS, THE CONTROL SYSTEM WILL INITIATE CONTROL SIGNALS TO SHUT DOWN THE SECOND FUELING PUMP, LEAVING THE SYSTEM TO OPERATE AS DESCRIBED IN PARAGRAPH 3.

NOTE: THE LEAD FUELING SHUT DOWN AND RETURN TO IDLE CONDITION WILL BE AS DESCRIBED IN PARAGRAPH 3A.

IN THE EVENT A FUELING PUMP IS AUTOMATICALLY CALLED ON AND FAILS TO START OR FAILS AFTER SUCCESSFULLY STARTING (AS INDICATED BY OPEN CONTACTS ON THE ASSOCIATED PUMP DISCHARGE FLOW SWITCH FOR A 10 SECOND INTERVAL), THE AFFECTED FUELING PUMP WILL BE CALLED OFF AND THE NEXT IDLE FUELING PUMP IN THE PREDETERMINED SEQUENCE OF PUMPS WILL BE CALLED ON AUTOMATICALLY.

SYSTEM "LOOP FLUSH" MODE

UPON ESTABLISHING A REQUIREMENT TO FLUSH THE PIPING DISTRIBUTION SYSTEM "LOOP", PERFORM THE FOLLOWING SEQUENCE:

1. PLACE FUELING PUMPS HAND-OFF-AUTO SELECTOR SWITCHES (LOCATED IN CONTROL ROOM) TO THE "OFF" POSITIONS.
2. PLACE THE MODE SELECTOR SWITCH (LOCATED IN THE CONTROL ROOM) IN THE "LOOP FLUSH" MODE. THIS WILL ENERGIZE THE BPCV SOLENOIDS "A" AND "B" (OPENING THE BPCV).
3. POSITION MANUALLY OPERATED VALVES IN THE SYSTEM TO REQUIRED POSITIONS TO DIRECT FUEL THROUGH THE DESIRED FLOW PATH (I.E. TRANSFERRING FUEL FROM ONE OPERATING TANK TO ANOTHER, FLUSHING SUSPECT FUEL FROM LOOP PIPING AND ROUTING THIS FUEL THRU THE RECEIVING FILTER SEPARATOR'S, ETC.)
4. SELECT PUMP TO BE USED FOR FLUSHING. PLACE THE FUELING PUMP'S HAND-OFF-AUTO SELECTOR SWITCH IN THE "HAND POSITION. THIS WILL START THE PUMP.

NOTE: THE SECOND PUMP MAY BE STARTED MANUALLY TO OBTAIN A GREATER FLUSHING FLOW RATE.

5. FOLLOWING THE FLUSHING PROCEDURE, PLACE FUELING PUMP(S) HAND-OFF-AUTO SELECTOR SWITCH(ES) IN THE "OFF" POSITION. POSITION MANUALLY OPERATED VALVES TO THEIR NORMALLY OPENED OR CLOSED POSITIONS.
6. PLACE THE MODE SELECTOR SWITCH IN THE "REFUELING" MODE FROM THE "LOOP FLUSH" MODE, AND ALL FUELING PUMP SELECTOR SWITCHES BACK IN THE "AUTO" POSITIONS.
7. OBSERVE SYSTEM OPERATION TO ENSURE SYSTEM RETURNS TO PRESSURIZED IDLE CONDITION.

SYSTEM IN "PANTOGRAPH FLUSH" MODE

UPON ESTABLISHING A REQUIREMENT TO FLUSH THE PANTOGRAPH(S), PERFORM THE FOLLOWING SEQUENCE:

1. PLACE FUELING PUMPS HAND-OFF-AUTO SELECTOR SWITCHES (LOCATED IN CONTROL ROOM) THE "OFF" POSITIONS.
2. PLACE THE MODE SELECTOR SWITCH (LOCATED IN CONTROL ROOM) IN THE "PANTOGRAPH FLUSH" MODE. THIS WILL ENERGIZE THE FLUSHING VALVE (FV) SOLENOID, CLOSING THE VALVE. IT WILL ALSO ENERGIZED THE BPCV SOLENOIDS (OPENING THE BPCV).
3. POSITION MANUALLY OPERATED VALVES IN THE SYSTEM TO REQUIRED POSITIONS TO DIRECT FUEL THRU THE DESIRED FLOW PATH.
4. CONNECT PANTOGRAPH PRESSURE FUELING NOZZLE TO THE 2-1/2" D-1 NOZZLE ADAPTER.
5. SELECT PUMP TO BE USED FOR FLUSHING. PLACE THE FUELING PUMP'S HAND-OFF-AUTO SELECTOR SWITCH IN THE "HAND" POSITION. THIS WILL START THE PUMP AND CLOSE THE PCV. OPERATOR HAS TEN(10) SECONDS TO DEPRESS HYDRAULICALLY OPERATED "DEADMAN" CONTROL BEFORE PUMP SHUTS OFF.
6. USING HYDRAULICALLY OPERATED "DEADMAN" CONTROL FLUSH ONE PANTOGRAPH AT A TIME FOR THE DESIRED INTERVAL.
7. AFTER OPERATOR RELEASES "DEADMAN", STOP PUMP WITHIN TEN(10) SECONDS. OTHERWISE OPERATOR MUST "RESET" AUTOMATIC SHUT-OFF OF FUELING PUMP AT CONTROL ROOM PUMP CONTROL PANEL.

NOTE: THE ABOVE PROCEDURE (PARAGRAPH 4 THRU 7) SHALL BE REPEATED AT EACH AIRCRAFT DIRECT FUELING STATION.

8. FOLLOWING THE PANTOGRAPH FLUSHING PROCEDURE, PLACE FUELING PUMP'S HAND-OFF-AUTO SELECTOR SWITCH IN THE "OFF" POSITION. POSITION MANUALLY OPERATED VALVES TO THEIR NORMALLY OPENED OR CLOSED POSITIONS.
9. PLACE THE MODE SELECTOR SWITCH IN THE "REFUELING" MODE FROM THE "PANTOGRAPH FLUSH" MODE, AND ALL FUELING PUMP SELECTOR SWITCHES BACK IN THE "AUTO" POSITIONS.
10. OBSERVE SYSTEM OPERATION TO ENSURE SYSTEM RETURNS TO PRESSURIZED IDLE CONDITION.

EMERGENCY OPERATION-MICROPROCESSORS DOWN

IN THE EVENT BOTH MICROPROCESSORS ARE DOWN, THE SYSTEM MAY BE ACTIVATED FOR EMERGENCY REFUELING AS FOLLOWS:

1. PLACE ALL FUELING PUMP SELECTION SWITCHES IN THE "OFF" POSITION.
2. ENSURE SELECTED OPERATING TANK(S) INLET AND OUTLET VALVES ARE OPEN.
3. CLOSE INLET SIDE PLUG VALVE TO THE PCV.
4. MANUALLY BY-PASS SOLENOID "A" ON BPCV ALLOWING VALVE TO MODULATE AT SET POINT.
5. MANUALLY START FUELING PUMP(S) AS REQUIRED BY PLACING SELECTOR SWITCH(ES) IN THE "HAND" POSITION.

NOTE: OPERATOR IS REQUIRED TO CONTINUOUSLY VERIFY OPERATING TANK(S) FUEL LEVEL TO ENSURE AN ADEQUATE FUEL SUPPLY IS AVAILABLE. FUEL LEVEL VERIFICATION SHALL BE BY MEANS OF THE OPERATING TANK(S) GROUND LEVEL READING GAGE. UPON COMPLETION OF EMERGENCY OPERATION, OPERATOR SHALL OPEN INLET SIDE PLUG VALVE TO PCV, CLOSE SOLENOID BY-PASS VALVE ON BPCV AND RETURN FUELING PUMP SELECTOR SWITCHES TO THEIR ORIGINAL POSITIONS.

RELEASE OF PANTOGRAPH PRESSURE

OPERATOR MAY RELEASE PANTOGRAPH PRESSURE, BEFORE CONNECTING TO AIRCRAFT AND BEFORE OPENING REFUELING CONTROL VALVE, BY MEANS OF SPRING RETURN HANDLE LOCATED IN BYPASS AROUND PANTOGRAPH PRESSURE CONTROL VALVE (PPCV).

* EMERGENCY REFUELING USING RETURN LINE

IN THE EVENT THE 8 INCH FUEL SUPPLY LINE TO THE AIRCRAFT DIRECT FUELING STATION MUST BE SHUT DOWN, EMERGENCY REFUELING THRU THE RETURN LINE CAN BE USED WHILE OPERATING REFUELING PUMP MANUALLY.
METHOD 1.-CLOSE MANUALLY OPERATED VALVES V-5, V-8, V-11, V-13.
2.-OPEN MANUALLY OPERATED VALVES V-6, V-15

IF SYSTEM CONTAINS ISOLATION VALVE(S), AN ADDITIONAL FLOW PATH FOR EMERGENCY REFUELING THRU RETURN LINE WOULD BE AS FOLLOWS:
1.-CLOSE MANUALLY OPERATED VALVES V-5, V-8, V-9, V-11
2.-OPEN MANUALLY OPERATED VALVES V-6, V-12
* SEE SHEET 17 FOR VALVE DESIGNATION NUMBERS.

EMERGENCY STOP AND RESET

1. DEPRESSION OF ANY EMERGENCY STOP PUSHBUTTON OR ACTUATION OF THE FIRE ALARM SYSTEM SHALL STOP FUELING PUMPS AND DE-ENERGIZE THE EMERGENCY SHUT-OFF VALVE'S SOLENOID CAUSING THE VALVE TO CLOSE. THIS ACTION IS EXECUTED WITHOUT REGARD FOR WHETHER PUMPS WERE AUTOMATICALLY CALLED ON OR MANUALLY STARTED.
2. IN ORDER TO RESET SYSTEM AFTER AN ALARM, DEPRESS "RESET" PUSHBUTTON LOCATED AT PUMP CONTROL PANEL AFTER RESETTING THE INITIAL ACTIVATED EMERGENCY STOP PUSHBUTTON STATION AND/OR FIRE ALARM SYSTEM.

FLUSHING VALVE (FV) OPERATION

CONDITION	VALVE ACTION	SOLENOID
"LOOP FLUSH" MODE	OPEN	DE-ENERGIZED
"PANTOGRAPH FLUSH" MODE	CLOSE	ENERGIZED
"REFUELING" MODE	OPEN	DE-ENERGIZED

BACK PRESSURE CONTROL VALVE (BPCV) SOLENOID

CONDITION	VALVE ACTION	SOLENOID "A"	SOLENOID "B"
"REFUELING" MODE PUMP START-UP	ENABLE	ENERGIZED	DE-ENERGIZED
"REFUELING" MODE-PRIOR TO LEAD PUMP SHUT-OFF	CLOSE	DE-ENERGIZED	DE-ENERGIZED
"LOOP FLUSH" AND "PANTOGRAPH FLUSH" MODES	OPEN	ENERGIZED	ENERGIZED

PRESSURE CONTROL VALVE (PCV) OPERATION

CONDITION	VALVE ACTION	SOLENOID
ANY PUMP ON (AUTO OR HAND)	CLOSE	ENERGIZED
ALL PUMPS OFF (AUTO OR HAND)	ENABLE	DE-ENERGIZED

REVISION	DESCRIPTION	DATE	APPROVED

SUPERSEDES PREVIOUS EDITIONS OF THIS DRAWING

Robert and Company
Architects Engineers Planners
96 Poplar Street, N.W. Atlanta, Georgia 30303

DSGN. BEASLEY/HENDERSON
DR. COBB
SUPV. L. BEASLEY
CH. ENGR. SLUTZ
SUBMITTED BY: DATE: 12-1-90
EIC.
BR.HD.
FPE.
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EFD FOR COMMANDER NAVFAC

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WASHINGTON, D.C.
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APPROVED FOR CHIEF OF STAFF, U.S. AIR FORCE
CHIEF, ENGINEERING DIVISION
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AIR FORCE STANDARDS
AIRCRAFT DIRECT FUELING SYSTEM
TYPE IV

UNVERIFIED DRAFT
SCHEME B-
SEQUENCE OF OPERATION

SCALE: AS NOTED
SPEC. NO. 78-24-29-88-AF
SHEET 8
DRAWING NO. AW 78-24-29