SAN JOSE COMPUTER TRAFFIC CONTROL PROJECT

PROGRAM DOCUMENTATION-OPERATIONS MANUAL

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P R E F A C E

THE APPROACH TO TRAFFIC SYSTEM DEVELOPMENT USED AT THE SAN JOSE COMPUTER TRAFFIC CONTROL PROJECT IS BASED ON THE ASSUMPTION THAT MAN'S OBSERVATIONAL POWERS CANNOT COPE WITH A COMPLEX PROBLEM AS HERE PRESENTED, AND THAT HIS EVALUATORY TECHNIQUES MUST BE QUANTIFIED, IF MEANINGFUL IMPROVEMENTS ARE EXPECTED. SINCE THE COMPUTER PROVIDES THE ENORMOUS ABILITY IN DATA INGESTION, MANIPULATION, AND REACTION SPEED WHICH MAN LACKS, THE ENERGIES APPLIED BY HIM CAN BE ALMOST ENTIRELY ANALYTICAL.

THEREFORE, OUR CHORE IS TO DESIGN AND INSTALL A METHOD OF PROCESS SYSTEM SELF MANAGEMENT (WHICH IS OCCASIONALLY LABELED A 'CLOSED LOOP SYSTEM') BY WHICH MAN'S ANALYTICAL ABILITY AND THE MACHINE'S SPEED AND POWER CAN BE COMBINED FOR MAXIMUM EFFICIENCY.

THE 'CLOSED LOOP SYSTEM' REVOLVES AROUND FEEDBACK. THREE MAJOR AREAS OF CONCERN CAN BE ISOLATED IN THE CLOSED LOOP. THEY ARE, SURVEILLANCE (VERIFICATION OF DETECTOR PERFORMANCE), EVALUATION (COMPARISON OF CONTROL TACTICS USING VERIFIED DATA), AND CONTROL (RESEARCH OF CONTROL THEORY AND HYPOTHESES). WE HAVE CENTERED THE MAJORITY OF OUR COMPUTER WORK IN THE SURVEILLANCE AREA FOR TWO REASONS. FIRST, THE DATA MUST BE VERIFIED BEFORE ANY EVALUATION OF CONTROL TACTICS CAN HONESTLY OR ACCURATELY BE ACCOMPLISHED. SECONDLY, THE LIMITED SIZE OF THE STAFF PROHIBITED FULL IMPLEMENTATION OF ALL THREE AREAS AT ONCE.

IN THE PAST, DATA COLLECTION HAS BEEN ESSENTIALLY MANUAL, EXPENSIVE, AND SPORADIC AT BEST. VOLUME MEASUREMENTS WERE THE ONLY DATA WHICH HAD ANY HOPE OF BEING ACCURATE. ALSO, MEASUREMENTS BY MANUAL TECHNIQUES, SUCH AS VOLUME COUNTS AND FLOATING CARS, HAVE MOST OF THE ERROR OR VARIANCE DUE TO THE VARIATION

OF THE OBSERVER, NOT THE TRAFFIC. UNFORTUNATELY, MOST OF THE THEORY AVAILABLE TO THE ENGINEER TODAY HAS BEEN BASED ON AND SUBSTANTIATED BY THIS SKETCHY DATA BASE.

WITH THE APPLICATION OF THE DIGITAL COMPUTER, THE SCIENCE OF TRAFFIC CONTROL GAINED A NEW TOOL WITH THE POWER TO EXPOSE THE MYTHS AND ERRORS OF THE PAST. THEORY NEVER BEFORE POSSIBLE IS NOW READY TO BE IMPLEMENTED. WITH THE COMPUTER, THE ENGINEER CAN ESTABLISH LARGE, ACCURATE DATA BASES AND TEST HIS THEORIES WITH CONFIDENCE.

THIS DOCUMENT CONTAINS SOME OF THE PROGRAMS WHICH PROVIDE SURVEILLANCE, EVALUATION, AND CONTROL FOR THE SAN JOSE TRAFFIC CONTROL PROJECT SYSTEM. THE SURVEILLANCE PROGRAMS ARE THE MOST ABUNDANT FOR THE REASONS EXPLAINED PREVIOUSLY. THERE ARE OTHER PROGRAMS TO (1) ANALYZE (PLOT, ORDER, AND DUMP) FIVE MINUTE OR FIVE SECOND DETECTOR VOLUMES, (2) DETERMINE AND ANALYZE FLOW PRIORITY PATHS (TRACES), AND (3) DETERMINE (GRAPHICALLY AND STATISTICALLY) MEASUREMENT RELATIONSHIPS. ANOTHER SET OF PROGRAMS IS USED TO INITIALIZE, LOAD, AND DUMP THE DISK FILES USED BY ONE OR MORE OF THE OTHER PROGRAMS.

T A B L E O F C O N T E N T S

P R O G R A M   D O C U M E N T A T I O N   I N D E X

SUBPROGRAM DOCUMENTATION INDEX

R E S E A R C H   S Y S T E M   O U T L I N E

OBJECTIVE-

IMPROVE GREEN TIME ALLOCATIONS ON A GRID NETWORK OF STREET INTERSECTIONS (I.E., DETERMINE GREEN TIME PRIORITIES AND EVALUATE INCREMENTAL GREEN TIME STRATEGIES USING VERIFIED DATA).

PROCEDURE-

I. VERIFY DETECTOR PERFORMANCE (SO THAT FOLLOWING STEPS-- II & III-- WILL BE VALID)

  A) COMPILE DAILY INBOUND-OUTBOUND VOLUME RATIO (I/O RATIO) SUMMARIES (INOKJ)

    1) CHECK FOR DETECTOR FAILURES

    2) CHECK FOR GEOMETRIC CLOSURE

    3) STORE I/O RATIO STATISTICS

  B) ACCUMULATE DAILY DETECTOR VOLUME CARDS

  C) SET UP STANDARDS BASED ON A LARGE SAMPLE OF SIMILAR DATA

    1) I/O RATIOS (STIOV, IOAVG)

    2) LEG VOLUME AND RATIO RANGES (LVPKJ)

      A) TOTAL LEG

      B) MAXIMUM LANE LEG

    3) MAXIMUM DETECTOR PER LEG (LVPKJ)

    4) DETECTOR VOLUME RANGES (LVPKJ, DTRPA)

    5) INBOUND AND OUTBOUND VOLUMES (STIOV)

    6) LEG AND DETECTOR STANDARDS GENERATED FROM A BLANK STANDARDS FILE USING ADJUSTMENT PROCEDURE ON A DAILY BASIS (INOKJ, NOTE PART F)

D) COMPARE DAILY RESULTS TO STANDARDS

1) I/O RATIOS (INOKJ)

2) INBOUND AND OUTBOUND VOLUMES (BY HAND)

3) DETECTOR VOLUME RANGES (LCSKJ)

4) LEG VOLUME AND RATIO RANGES (LCSKJ)

5) MAXIMUM DETECTOR PER LANE (LCSKJ)

E) STORE LEG FAILURE CHECKS (LCSKJ)

F) ADJUST (EXPAND) LEG AND DETECTOR STANDARD RANGES (INOKJ)

1) USING VERIFIED DATA FOR EACH INTERSECTION

2) VERIFICATION-

A) NO LEG DETECTOR FAILURES

B) I/O RATIO WITHIN 5 PERCENT OF STANDARD

G) TROUBLE SHOOT STANDARDS VIOLATIONS

1) NOTE DETECTOR FAILURES

A) BAD DETECTOR LISTS (INOKJ, LCSKJ)

B) DETECTOR VOLUME LISTS (INOKJ, GRID)

2) NOTE LANE BLOCKAGE

A) MAXIMUM DETECTOR PER LEG SHIFT (LCSKJ)

B) HIGH VOLUMES ON ADJACENT LANE DETECTORS (LCSKJ)

3) TAKE ACTION ON PROBLEM

A) REPAIR DEFECTIVE EQUIPMENT (ELECTRICIAN)

B) RELOCATE DETECTOR LOOPS (PUBLIC WORKS)

C) ADJUST LEG OR DETECTOR RANGES (LCSLD, DLMLD)

D) ADJUST I/O RATIOS (DIDLD)

II. DETERMINE GREEN TIME PRIORITIES

A) FIND FLOW PRIORITIES IN THE INTERSECTION NETWORK (TRACE)

1) USING TOTAL PERIOD MEASUREMENT VALUES
(I.E., VOLUME, STOPS, DELAYS, DELAY/VEHICLE, STOP PROBABILITY, SECONDS OF GREEN TIME/VEHICLE, LANE OCCUPANCY, VEHICLES/CYCLE, LANE OCCUPANCY/VEHICLE, AND DELAY/STOP)

2) EVALUATE GIVEN FLOW ROUTES (E.G., TRACES)

3) FIND THE HEAVIEST TRACES BETWEEN GIVEN INTERSECTIONS

A) USING THE TOTAL LEG

B) USING THE MAXIMUM LANE PER LEG

B) FIND OPPOSING LEG PEAKS

1) PLOTS OF FIVE MINUTE VOLUMES (MS5PT, SYSPT)

2) PEAK VOLUME HOURS (PEAK)

C) DETERMINE GREEN TIME SPLIT RATIOS (INOKJ, LVPKJ, SPLIT)

1) BASED ON VOLUMES

2) FOR 2 PHASE INTERSECTIONS ONLY

D) COMBINE PEAKS AND SPLIT RATIO RESULTS

1) ASSIGN GREEN TIMES FOR VARIOUS PERIODS OF THE DAY WITHIN THE PHASE STRUCTURE

2) DETERMINE PROBLEM AREAS NECESSITATING GEOMETRIC SOLUTIONS RATHER THAN GREEN TIME ADJUSTMENT

III. EVALUATION OF GREEN TIME CHANGES

A) SYNTHESIZE MEASUREMENT RELATIONS

1) GRAPHICAL AND LINEAR CORRELATION (CDPKJ)

A) PLOT SELECTED MEASUREMENT COMBINATIONS (PRODUCT OR QUOTIENT) AGAINST OTHERS (MEASUREMENTS INCLUDE VOLUMES, STOPS, DELAYS, LANE OCCUPANCY, SPEED, PHASE LENGTH, CYCLE LENGTH, AND RECORD TIME)

B) PERFORM INCREMENTAL AND TOTAL LINEAR CORRELATION ANALYSIS

1) LINEAR EQUATION COEFFICIENTS

2) COEFFICIENTS OF CORRELATION

2) RANK ORDER CORRELATION (DCORD)

A) LIST DETECTOR MEASUREMENTS IN RANK ORDER FOR TOTAL PERIOD OF RECORD

B) ANALYZE RANK ORDER CORRELATION BETWEEN EACH PAIR OF MEASUREMNTS

C) MEASUREMENTS INCLUDE VOLUMES, STOPS, DELAYS, STOPS PROBABILITY, DELAY PER VEHICLE, AND DELAY PER STOP

B) USE RELATIONSHIPS TO REDUCE DATA COLLECTION

C) SET UP CRITERIA

   1) DETERMINE CRITERIA

      A) COSTS (TIME, WEAR, LOST USE, ETC)

      B) ECOLOGICAL EFFECTS

   2) SET UP OBJECTIVE FUNCTION COMBINING WEIGHTED CRITERIA WITH RESPECT TO THE MEASUREMENTS

D) OPTIMIZE CHANGES

   1) MAKE CHANGES IN INCREMENTS

   2) VERIFY DATA

      A) I/O RATIOS (INOKJ)

      B) LEG VOLUMES (LCSKJ)

      C) DETECTOR VOLUMES (INOKJ,LCSKJ)

   3) MEASURE USING OBJECTIVE FUNCTION AND VERIFIED DATA

E) REPEAT STEPS I, II, AND III UNTIL SATISFIED

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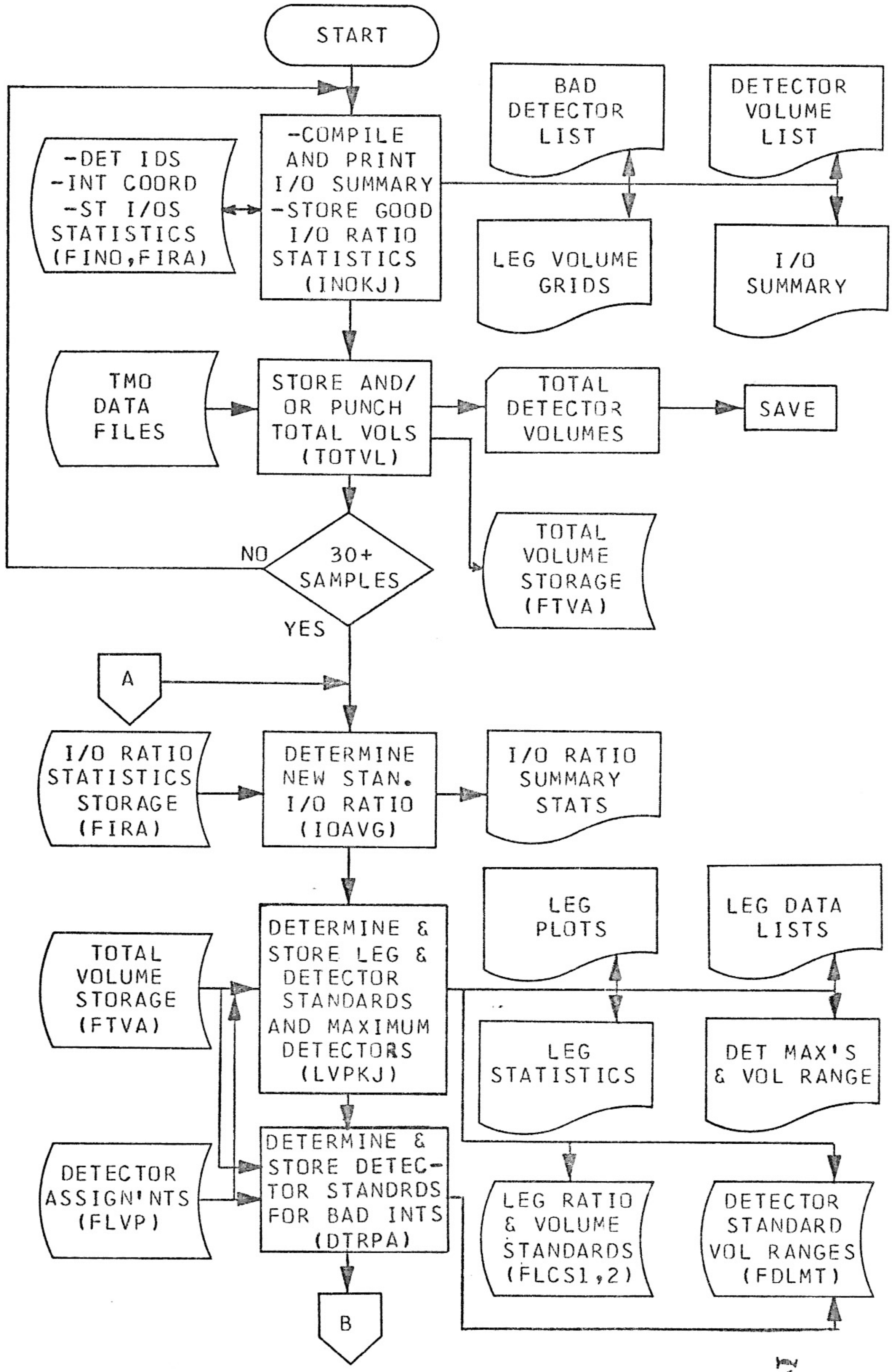
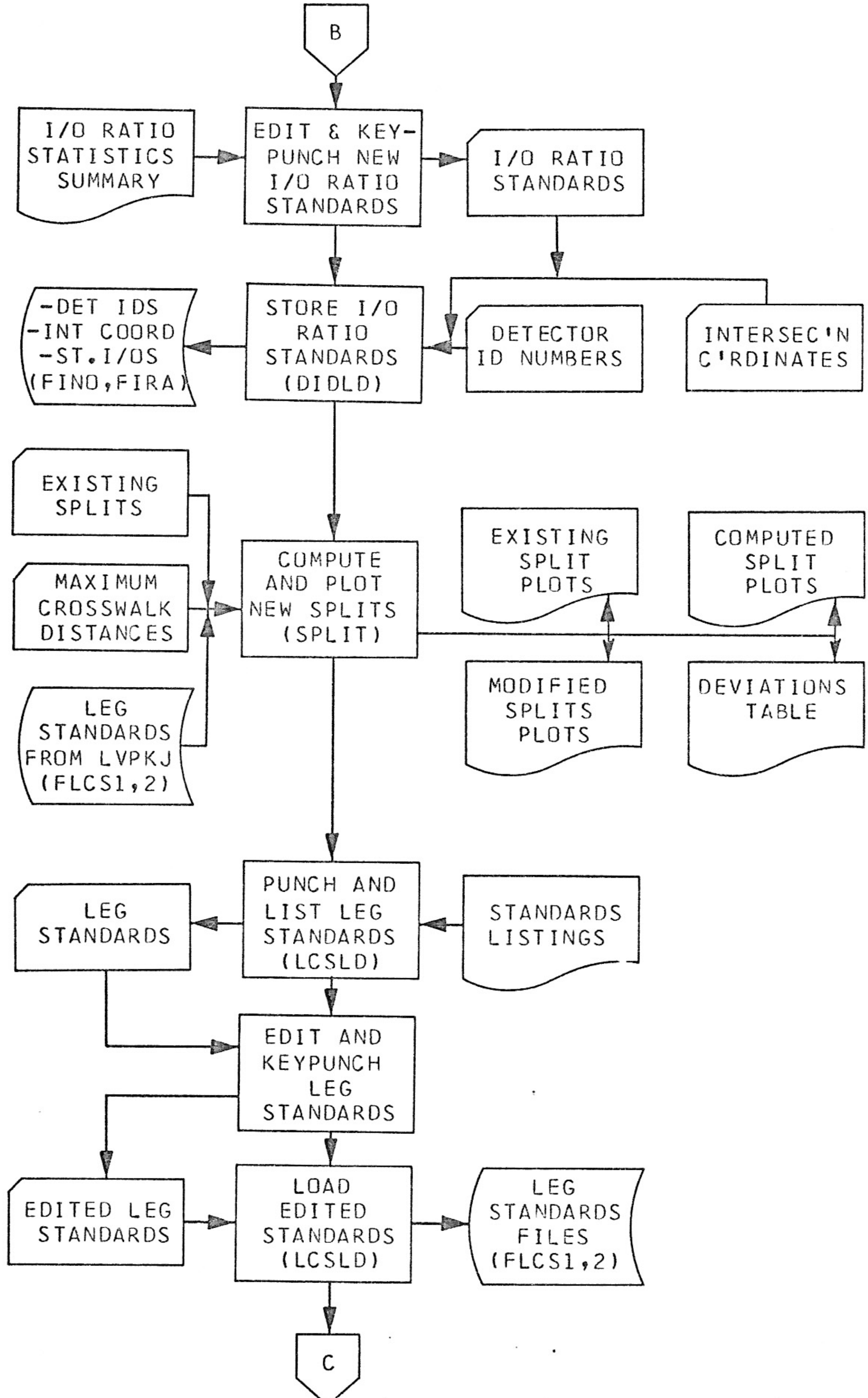
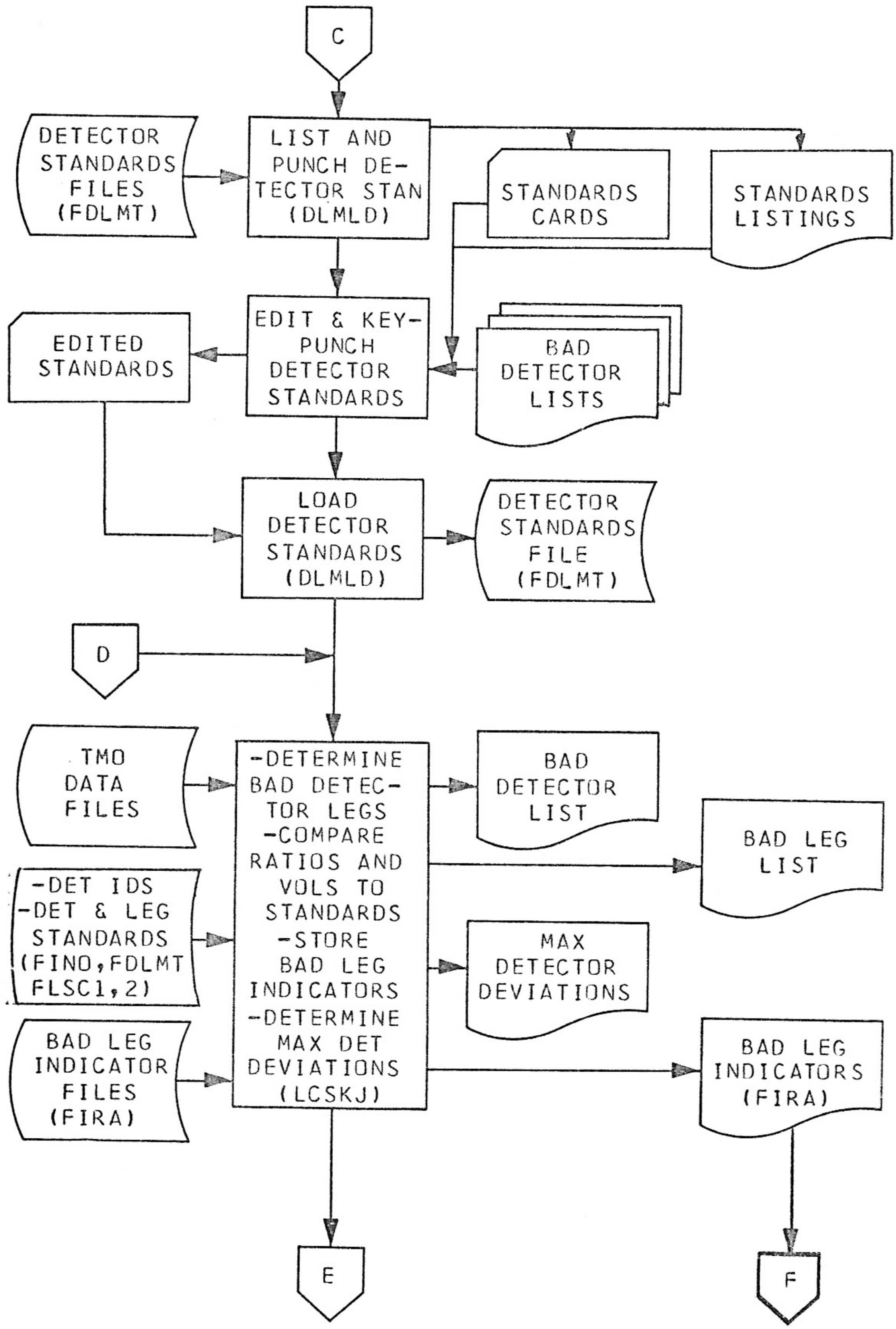
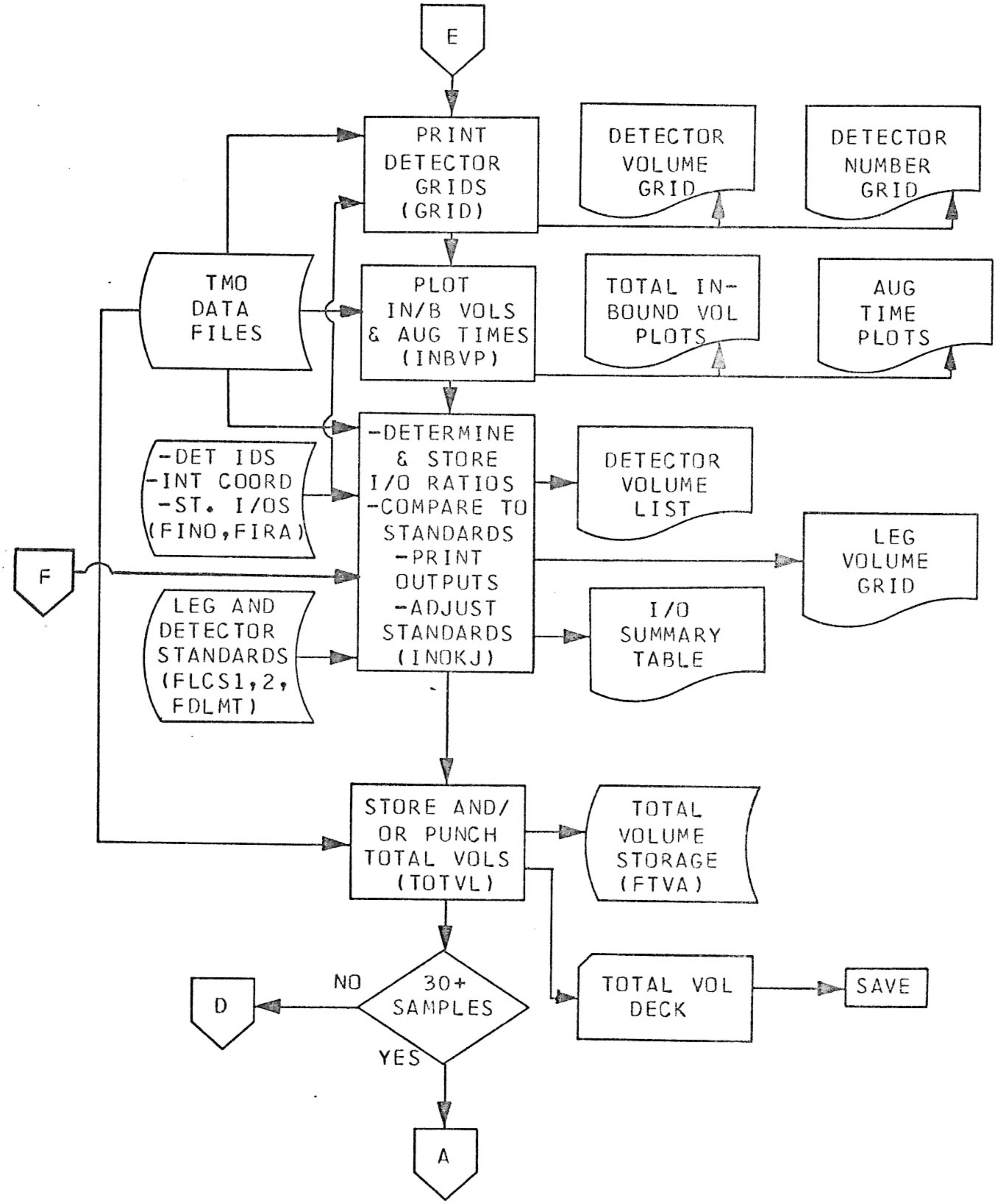



B
I/O RATIO STATISTICS SUMMARY
EDIT & KEY-PUNCH NEW I/O RATIO STANDARDS
I/O RATIO STANDARDS
-DET IDS
-INT COORD
-ST.I/OS
(FINO,FIRA)
STORE I/O RATIO STANDARDS (DIDLD)
DETECTOR ID NUMBERS
INTERSEC'N C'RDINATES
EXISTING SPLITS
MAXIMUM CROSSWALK DISTANCES
LEG STANDARDS FROM LVPKJ (FLCS1,2)
COMPUTE AND PLOT NEW SPLITS (SPLIT)
EXISTING SPLIT PLOTS
COMPUTED SPLIT PLOTS
MODIFIED SPLITS PLOTS
DEVIATIONS TABLE
LEG STANDARDS
PUNCH AND LIST LEG STANDARDS (LCSLD)
STANDARDS LISTINGS
EDIT AND KEYPUNCH LEG STANDARDS
EDITED LEG STANDARDS
LOAD EDITED STANDARDS (LCSLD)
LEG STANDARDS FILES (FLCS1,2)
C

S U R V E I L L A N C E   F L O W C H A R T   (C O N)




E
PRINT DETECTOR GRIDS (GRID)
DETECTOR VOLUME GRID
DETECTOR NUMBER GRID
TMO DATA FILES
PLOT IN/B VOLS & AUG TIMES (INBVP)
TOTAL IN-BOUND VOL PLOTS
AUG TIME PLOTS
-DET IDS
-INT COORD
-ST. I/OS
(FINO,FIRA)
-DETERMINE & STORE I/O RATIOS
-COMPARE TO STANDARDS
-PRINT OUTPUTS
-ADJUST STANDARDS
(INOKJ)
DETECTOR VOLUME LIST
LEG VOLUME GRID
F
LEG AND DETECTOR STANDARDS (FLCS1,2, FDLMT)
I/O SUMMARY TABLE
STORE AND/ OR PUNCH TOTAL VOLS (TOTVL)
TOTAL VOLUME STORAGE (FTVA)
NO
30+ SAMPLES
YES
D
TOTAL VOL DECK
SAVE
A