Research and Development for Onboard Navigation (ONAV) Ground Based Expert/Trainer System

Test Report

Preface

This research was conducted under the auspices of the Research Institute for Computing and Information Systems by LinCom Corporation under the direction of Daniel C. Bocshsler. Terry Feagin, Professor of Computer Science at the University of Houston - Clear Lake, served as the technical representative for RICIS.

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Research and Development for Onboard Navigation (ONAV)

Ground Expert/Trainer System

TEST REPORT

(Deliverable E)

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Performed Under:

Project No. AI.8
Cooperation Agreement no. NCC9-16
Subcontract No. 005

August, 1988

TEST REPORT FOR THE ONBOARD NAVIGATION (ONAV)

CONSOLE EXPERT/TRAINER SYSTEM

ENTRY PHASE

August 1988

LinCom Corporation
Houston Texas

Acknowledgments

This document was prepared with the appreciated participation of several people:

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Section 1

SUMMARY

This document presents the test report for the Onboard Navigation (ONAV) Console Expert/Trainer Entry Expert System. It includes a background summary of testing procedures used and summaries of test results. General conclusions are also presented.

Section 2

INTRODUCTION

2.1 PURPOSE

This document describes the test results for the ONAV Entry phase system. A summary of the test methods and analysis results are included.

2.2 APPLICABLE DOCUMENTS

The following document represented the test plan which guided the activities described in this test report:

Test Plan for the Onboard Navigation (ONAV) Console Expert/ Trainer System, Entry Phase, LinCom Corporation, for RICIS Proj. No. AI-8, Coop. Agrmt. No. NCC9-16, Subcontract No. 005, April 15, 1988.

The test plan and this test report are obviously interrelated. Many sections of the test report correlate exactly to section in the test plan, where objectives and recommended procedures are given. The test plan should be examined concurrently with the test report to provide a comprehensive discussion of the ONAV Entry expert system testing.

Additionally, this test report makes reference to aspects of the testing activity that are described in the following user's guide for the ONAV Entry system:

User's Guide for the Onboard Navigation (ONAV) Console Expert/Trainer System, Entry Phase, Final Version, LinCom Corporation, April, 1988.

Section 3

TEST RESULTS

3.1 BACKGROUND

A good design is a necessity for a good test program. It has been said over the years with software engineering that design is more than an "ounce" of prevention for testing. At the same time, design implies order and testing may uncover design changes or errors. Therefore, having a good design available when doing test is very important to an orderly, efficient and effective verification process and the ultimate robustness and success of the system.

Specific testing experiences and results will be described in the following sections. The discussions will be organized under the heading of analysis/results.

3.2 RULE TESTS

3.2.1 Inspection

Analysis/Results:

The XREF program was run for all the rule groups into which the Entry knowledge base had been broken into. Several typographical errors were found. These were subsequently corrected. It is important to note that, while we did not have a complete list of all known valid patterns, the context of the Entry phase expert system provided a basic guide as to what a correct and/or incorrect pattern was.

A byproduct of this process was an increased awareness of the importance of looking at every part of a rule with the same rigorousness as the patterns themselves. Sensitivity to spelling of rule names for example, while not as significant functionally as rule patterns, was gained. Out of this came the realization that greater consistency was needed for the rule names within the various rule groups of the ONAV knowledge base. Such consistency aided cross referencing and more detailed correlations of rule information. Some renaming of rules was performed to accomplish this.

3.2.2 Compilation

Analysis/Results:

The "(rules)" list generated by the CLIPS environment compared well with the XREF listing. No discrepancies were found. As was mentioned in section 3.2.1, the rule name inconsistencies were very evident when performing this test.

In a sense, this test "exercised" both CLIPS and the XREF program. In doing the compilation to check that all rules compile, this certainly is useful from the standpoint of having readable CLIPS rules. On the other hand, having to check explicitly for duplicate rule names might not be necessary if this particular function was handled explicitly or implicitly by CLIPS or XREF. As it was during testing, we did not have complete information as to the extent of these capabilities in CLIPS and XREF. Therefore, this test to check rule names was necessary, and ensured that no problems of this type were present.

3.2.3   Default Data Activations

Analysis/Results:

During the initial preparation for this test, it was found that the ONAV rule file "control.r" had to be modified for this test. The modification was very simple. The rule that begins the rule control flow performs, among other things, the assertion of facts from the comps file into the rule base. For this test, this was not desired and was the opposite of what this test was trying to accomplish. Because of this situation, the "control.r" file used in this test had the call to "fact assertion" deleted (commented out actually). In addition, the "single step" feature of ONAV (see user's guide reference in the applicable documents section 2.2) was used to make the ONAV system execute one and only one complete cycle through the control flow. This usage can be seen in the listing of the test results.

The test was run using the batch file shown in Appendix A. The results of running the batch file are provided in Appendix B. An examination of these results shows that the only rules that executed with the default data were control flow rules, with one exception noted in the IMU rules. The control flow rule action was to be expected and considered normal. The unexpected rule execution occurred in the IMU rule group. Here, IMU status light rules executed to control the expert system display. While initially unexpected, analysis showed this to be acceptable and appropriate given the values of the default data and the function of the rules that executed.

3.2.4   Individual Rule Sets Loaded

Analysis/Results:

As testing activities progressed, this particular test as defined was determined to be of marginal or no value. Subsequently, a decision was made not to perform this test. The reasoning here was that: 1) the original intent of this test and even more testing would be accomplished by a later series of tests; therefore, little or no benefit would be gained by doing this test, and 2) an excessive amount of preparation time is required to perform this test, in that each and every rule in the expert system would have to have a special data set developed to trigger the patterns in that rule. Taking this into consideration, and given that later testing would cover this, it was decided to eliminate this test.

3.2.5   All Rule Sets Loaded

Analysis/Results:

This test was not performed, for the same reasons as described in section 3.2.4. The same rationale applied since the tests described in sections 3.2.4 and 3.2.5 are variations of each other.

3.3 GROUP TESTS

3.3.1   Functional Inspection

Analysis/Results:

This part of the testing involved detailed examination of rules and specification paperwork, as compared to most of the previous computer based testing performed. The rule base of the expert system was examined systematically, one group at a time. For each of these groups, the left and right hand side patterns and actions of each rule were compared to the Entry phase knowledge requirements specification:

> "Knowledge Requirements for the Onboard Navigation (ONAV) Console Expert/Trainer System," Entry Phase Specifications, Version 1.1, LinCom Corporation, April 1988.

Numerous discrepancies in patterns were found, particularly in the form and syntax of patterns used in more than one group of rules. For example, a pattern used in the IMU rules was referenced in some of the TACAN rules, yet the pattern was not consistent in format in the two groups. In other situations, discrepancies between the code and the specification were ambiguous and required consultation with the personnel who provided the original inputs and expertise for the knowledge specifications. In several instances, the original thinking of the expert was not consistent with the expert's current thinking and therefore resulted in a modification to the specification as well as the rule code.

This test could be considered the first point where the code is examined in a comprehensive, integrated manner. In general, more than one person is tasked with developing rule groups which creates situations for typical syntax inconsistencies to occur with respect an integrated rule base. Thus, this step in the testing process was considered to be particularly effective.

3.3.2 Functional Execution - Ordered Groups

Analysis/Results:

A decision not to perform this test was made for reasons similar to that discussed in section 3.2.4. The appropriateness of doing this test was outweighed by: 1) the partial satisfaction of test objectives by the test described in section 3.2.3. The sequencing mechanisms are, in part, implemented with control patterns within rule groups. Therefore, part of the original intent of this test had already been covered. In addition, it was found that effective results of salience type sequencing checks could only be obtained using realistic data, not canned "deffacts" default data. Further, such deffacts data would have required some "intrusive changes" to the rule sets to make the test situation function correctly (e.g., temporary modifications to rules to inhibit infinite loops situations).

3.3.3 Functional Execution - Unordered Groups

Analysis/Results:

This test was not performed for many of the same reasons as given above.

3.4 INTERFACE TESTS

3.4.1 Input File Sources

Analysis/Results:

This test was partially successful in meeting the test objectives. The repairs file used to assign a unique number to each of the data items sent to the expert system is provided in Appendix C. Examination of the results of running this test quickly showed an unanticipated problem with the specification of the test. The assignment of a unique number to each input into the expert system was done before the data preparation processing, not after as was implied in the test specification.

The numeric form of the unique numbers was not consistent with the flag conversion, scaling, averaging, etc. performed in the data preparation process. Out of the data preparation process comes both symbolic values (e.g., high or low, which are no longer numbers and are difficult to correlated directly with the assigned unique number itself), and numeric values.

Therefore, the results of this test enabled the end-to-end data flow of some, not all, of the input data parameters to be examined. The results obtained were used as much as possible to trace the proper flow. The valid data passing through the data preparation process showed correct results. The checkoff of data sources, in support of the test described in section 3.4.2, was completed and successful.

3.4.2   Default Data Sources

Analysis/Results:

The facts given in the listing from this test were used, along with the checkoff list from the test described in section 3.4.1, to further ensure that all data patterns in the rule base had some clearly defined source. Again, this test provided an opportunity to really understand what was in the rule base from the standpoint of code implementation.

3.4.3   Non-HSTD Inputs

Analysis/Results:

This test was performed, but the procedure was done by code inspection rather than logging data in a dribble file as the original procedure specified. This was felt to be a more time efficient and effective method. The code which asserted each of the inputs was examined and the exact form of the fact that would be asserted was written down. This form was then compared to the pattern of the corresponding rule in the rule base. No discrepancies were found.

3.4.4   HSTD Inputs

Analysis/Results:

A procedure similar to that described in section 3.4.3 was performed.

3.4.5   Identify Function Calls

Analysis/Results:

This type of test is done inherently each time a rule set or sets is loaded into a CLIPS environment. Part of CLIPS' initial processing of rules is to make sure that all references to functions in the rules can be traced to the "defined functions" that CLIPS has access to. As a consequence of loading the rule

sets in previous tests, no unknown function references were indicated by CLIPS. Therefore, all function references were present as expected and this test, as originally defined, did not have to be performed.

3.4.6   Function Call Returns

Analysis/Results:

This test was performed by inspection of the calling arguments in the rule function calls and the outputs of the defined C language functions defined for the expert system. This process was also verified as part of previous tests in that incorrect types of returned data from function calls will often result in a CLIPS syntax or data type or data usage error during execution.

3.4.7   Status Light Indicators

Analysis/Results:

This test was performed by taking the "output.r" rule set and adding a test fact for each status light on the screen to the deffacts section of the ruleset which was defining the light locations. This test was done for all status lights in each of three light modes: normal, inverse, and blink. Appendix D presents a listing of one of the three versions of the output rule set showing how the status light deffacts data was specified.

Performing this test in this manner was a simplication over the original test definition because the status light indicators on the expert system screen all lit up essentially at the same time and stayed on the screen until the expert system was completely stopped. No anomalies were found.

3.4.8   User Interface Command Acceptance

Analysis/Results:

The procedure for this test was altered and consisted of both inspection of the rules and user interface fact assertion code, and partially by the successful display of the appropriate configuration windows as illustrated in the ONAV Entry User's Guide (see applicable documents section 2.2). All inputs were found to be functioning properly.

3.5 ACCEPTANCE TESTS

Due to the unavailability of experts required to evaluate such testing, which was outside the control of ONAV testing activities performed here, acceptance testing was not completed. Initial data files were made available with which to begin testing and previous testing activities resulted in the expert system being fully prepared for the detailed types of investigation and examination carried out during acceptance test activities.

The test plan for acceptance testing remains fully valid and the appropriate organizations have been made cognizant of this situation.

Section 4

CONCLUSIONS AND RECOMMENDATIONS

4.1.1   Design Structure

The design of the Entry expert system rule base, with numerous
functional groups, was of significant benefit in both organizing
and carrying out the tests that were performed. Such a breakdown
of rule bases ensures that individual aspects of rules can be
more easily tested, without having to deal with unnecessary
interactions from or with other rules in the rule base.

4.1.2   Development Techniques

With respect to the accuracy of the coding effort, a data item
dictionary (i.e., pattern name, format, and legal values) for the
entire design would have been useful and would help avoid
inconsistencies and inaccuracies in syntax and inter-rule-group
integration. This type of item, while certainly an impact on
testing of the rule base, is definitely a resource and time
consideration during development activities.

4.1.3   Testing Results

The results of the testing performed demonstrated that the ONAV
Entry expert system performs very well. Functional processing was
found to be very complete and the various functional parts of the
rule base were well integrated, both from a rule base standpoint
as well as with non-rule components of the expert system (e.g.,
user interface).

4.1.4   Languages

The use of CLIPS and C was very advantageous in the sense of
using a consistent language throughout the expert system.

APPENDICES

A   -   Batch file from test 4.1.3.1 described in section 3.2.3 of this document.

B   -   Dribble file output from test 4.1.3.1 described in section 3.2.3 of this document.

C   -   Repair test file for test 4.3.1.1 described in section 3.4.1 of this document.

D   -   Interface light rule set modified to support status light checks for test 4.3.2 described in section 3.4.7 of this document.

APPENDIX

A   -   Batch file from test 4.1.3.1 described in section 3.2.3 of this document.

```
(dribble-on "testsupport/b4.1.3.1results")
(watch all)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/2state.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/baro.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/drag.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/hstd.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/inu.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/init.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/msbls.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/operator.r")
(reset)
(assert (single step))
```

```
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/output.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/runway.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/state.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/tacan.r")
(reset)
(assert (single step))
(run)
(clear)
(load "Dan/tables.r")
(load "Dan/control.r")
(load "Dan/telemetry.r")
(reset)
(assert (single step))
(run)
(clear)
(dribble-off)
(exit)
```

APPENDIX

B   —   Dribble file output from test 4.1.3.1 described in section 3.2.3 of this document.

```
CLIPS> (watch all)
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-exclude-lru
Processing deffacts block: tables-lru-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-scan-qualities
Processing deffacts block: tables-enable-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j+1
Compiling rule: control-change-phases +j+j+1
Compiling rule: control-end-of-cycle +j+1
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "Dan/3state.r")
Processing deffacts block: monitoring-3state-phases
Processing deffacts block: initial-3state-facts
Compiling rule: end-3-state-now +j+j+j
Compiling rule: gnd-to-state-comparison =j+j+j+j+1
Compiling rule: state-to-state-comparison-1 =j+j+j+j+1
Compiling rule: state-to-state-comparison-2 =j=j+j+j+j+1
Compiling rule: state-to-state-comparison-3 =j=j=j+j+j+1
=j=j=j+j+j+j+1
Compiling rule: state-to-state-comparison-4 =j=j=j=j+1
Compiling rule: zero-delta-state-occurred =j+j+j+j+1
Compiling rule: delta-state-occurred =j+j+j+j+1
Compiling rule: delta-state-cleanup =j+j+1
CLIPS> (reset)
f-0    (initial-fact)
f-1    (common-lru p-1-3    c-1)
f-2    (common-lru p-1-2    c-1)
f-3    (common-lru p-1-1    c-1)
f-4    (common-lru p-2-3    c-2)
f-5    (common-lru p-2-2    c-2)
f-6    (common-lru p-2-3    c-2)
f-7    (excluded-lru p-1-2)
f-8    (excluded-lru p-1-3)
f-9    (excluded-lru p-2-3)
f-10   (lru-in-pair p-1-1    2)
f-11   (lru-in-pair p-1-1    3)
f-12   (lru-in-pair p-1-2    3)
f-13   (lru-in-pair p-2-2    3)
f-14   (lru-in-pair p-2-3    2)
f-15   (min-miscompare p-3 3-2    zero zero zero)
f-16   (min-miscompare under zero zero)
f-17   (min-miscompare p-3-2)
```

```
f-18    (min-miscompare o50 zero zero)
f-19    (min-miscompare zero zero zero)
f-20    (min-miscompare zero under zero)
f-21    (min-miscompare under under under)
f-22    (min-miscompare o50 under under)
f-23    (min-miscompare over under under)
f-24    (min-miscompare zero o50 zero)
f-25    (min-miscompare under o50 under)
f-26    (min-miscompare o50 o50 o50)
f-27    (min-miscompare zero over zero)
f-28    (min-miscompare under over under)
f-29    (min-miscompare o50 over o50)
f-30    (max-miscompare over over over)
f-31    (max-miscompare zero zero zero)
f-32    (max-miscompare under zero zero)
f-33    (max-miscompare o50 zero o50)
f-34    (max-miscompare over zero over)
f-35    (max-miscompare zero under under)
f-36    (max-miscompare under under under)
f-37    (max-miscompare o50 under o50)
f-38    (max-miscompare over under over)
f-39    (max-miscompare zero o50 o50)
f-40    (max-miscompare under o50 o50)
f-41    (max-miscompare o50 o50 o50)
f-42    (max-miscompare over o50 over)
f-43    (max-miscompare zero over over)
f-44    (max-miscompare under over over)
f-45    (max-miscompare o50 over over)
f-46    (max-miscompare over over over)
f-47    (max-miscompare over over over good)
f-48    (fault-matrix under under under good)
f-49    (fault-matrix o50 under under velocity)
f-50    (fault-matrix over under under velocity)
f-51    (fault-matrix under o50 under attitude)
f-52    (fault-matrix over under under attitude)
f-53    (fault-matrix under under o50 attitude)
f-54    (fault-matrix under over o50 attitude)
f-55    (fault-matrix o50 o50 under resolver)
f-56    (fault-matrix over o50 under resolver)
f-57    (fault-matrix o50 over under resolver)
f-58    (fault-matrix over over under resolver)
f-59    (fault-matrix under under o50 bias)
f-60    (fault-matrix o50 under o50 bias)
f-61    (fault-matrix over under o50 bias)
f-62    (fault-matrix under under over bias)
f-63    (fault-matrix o50 o50 o50 drift)
f-64    (fault-matrix over o50 o50 drift)
f-65    (fault-matrix o50 over o50 drift)
f-66    (fault-matrix over over o50 drift)
f-67    (fault-matrix under o50 o50 suspect)
f-68    (fault-matrix over o50 o50 suspect)
f-69    (fault-matrix o50 over o50 suspect)
f-70    (fault-matrix over over o50 suspect)
f-71    (fault-matrix o50 o50 over suspect)
f-72    (fault-matrix over o50 over suspect)
f-73    (fault-matrix o50 over over suspect)
```

```
f-74   (fault-matrix over over over suspect)
f-75   (quality-table zero over good)
f-76   (quality-table under good)
f-77   (quality-table o50 suspect)
f-78   (quality-table over bad)
f-79   (tacan-quality under under under good)
f-80   (tacan-quality under under over noise)
f-81   (tacan-quality under o50 under bias)
f-82   (tacan-quality under o50 over noise)
f-83   (tacan-quality under over under bias)
f-84   (tacan-quality under over over noise)
f-85   (tacan-quality over under under timing)
f-86   (tacan-quality over under over noise)
f-87   (tacan-quality over o50 under timing)
f-88   (tacan-quality over o50 over noise)
f-89   (tacan-quality over over under timing)
f-90   (tacan-quality over over over noise)
f-91   (msbls-quality under under good)
f-92   (msbls-quality under o50 good)
f-93   (msbls-quality under over bad)
f-94   (msbls-quality o50 under good)
f-95   (msbls-quality o50 o50 good)
f-96   (msbls-quality o50 over bad)
f-97   (msbls-quality over under bad)
f-98   (msbls-quality over o50 bad)
f-99   (msbls-quality over over bad)
f-100  (measurement-name tacr range)
f-101  (measurement-name tacb bearing)
f-102  (measurement-name misr range)
f-103  (measurement-name misa azimuth)
f-104  (measurement-name mise elevation)
f-105  (units range feet)
f-106  (units bearing degrees)
f-107  (units azimuth degrees)
f-108  (units elevation degrees)
f-109  (units drag feet)
f-110  (units tacr feet)
f-111  (units baro feet)
f-112  (units misr feet)
f-113  (units tacb degrees)
f-114  (units misa degrees)
f-115  (units mise degrees)
f-116  (same-area 1 ...)
f-117  (same-area 2 ...)
f-118  (same-area 3 ...)
f-119  (same-area 4 ...)
f-120  (same-area 5 ...)
f-121  (same-area 6 ...)
f-122  (same-area 7 ...)
f-123  (same-area 8 ...)
f-124  (same-area 9 10 ...)
f-125  (same-area 10 11 ...)
f-126  (same-area 11 12 ...)
f-127  (same-area 12 13 ...)
f-128  (same-area 13 14 ...)
f-129  (same-area 14 13 ...)
```

```
==> f-130    (same-area 15 16)
==> f-131    (same-area 16 15)
==> f-132    (same-area 17 18)
==> f-133    (same-area 18 17)
==> f-134    (same-area 19 20)
==> f-135    (same-area 20 19)
==> f-136    (same-area 21 22)
==> f-137    (same-area 22 21)
==> f-138    (same-area 23 24)
==> f-139    (same-area 24 23)
==> f-140    (same-area 25 26)
==> f-141    (same-area 26 25)
==> f-142    (same-area 27 28)
==> f-143    (same-area 28 27)
==> f-144    (same-area 29 30)
==> f-145    (same-area 30 29)
==> f-146    (phase fact-assertion)
==> Activation  0  control-kickoff: f-146
==> Activation  1  next-phase fact-assertion monitoring)
==> f-147    (control-change-phases: f-147 f-146)
==> Activation  1  next-phase monitoring analysis)
==> f-148    (next-phase analysis output)
==> f-149    (next-phase output fact-assertion)
==> f-150    (first-sub-phase three-state three-state)
==> f-151    (state-quality 1 unknown)
==> f-152    (state-quality 2 unknown)
==> f-153    (state-quality 3 unknown)
==> f-154    (nav-3-state on)
==> f-155    (nav-3-state on)
CLIPS> (assert (single step))
CLIPS> (run)
FIRE  1  control-kickoff: f-146
FIRE  2  control-change-phases: f-147 f-146
==> f-146    (phase fact-assertion)
==> f-147    (phase monitoring)
==> Activation  2  control-kickoff-subphase: f-157 f-151
==> Activation  3  control-change-phase: f-148 f-157
FIRE  3  control-kickoff-subphase: f-157 f-151
==> f-158    (sub-phase three-state three-state)
FIRE  4  control-last-subphase: f-158
==> f-158    (sub-phase three-state three-state)
FIRE  5  control-change-phases: f-148 f-157
==> f-157    (phase monitoring)
==> f-159    (phase analysis)
==> Activation  5  control-change-phases: f-149 f-159
FIRE  6  control-change-phases: f-149 f-159
==> f-159    (phase analysis)
==> f-160    (phase output)
==> Activation  6  control-change-phases: f-150 f-160
FIRE  7  control-end-of-cycle: f-156 f-160
==> f-156    (control-end-of-cycle: f-156 f-160)
Rule fired
Run time is 0.7500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
```

ORIGINAL PAGE IS
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```
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: end-3-state-nav
Excising rule: gnd-to-state-comparison
Excising rule: state-to-state-comparison-1
Excising rule: state-to-state-comparison-2
Excising rule: state-to-state-comparison-3
Excising rule: state-to-state-comparison-4
Excising rule: zero-delta-state-occurred
Excising rule: delta-state-occurred
Excising rule: delta-state-cleanup
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lru-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "Dan/baro.r")
Processing deffacts block: monitoring-baro-phases
Processing deffacts block: analysis-baro-phases
Processing deffacts block: initial-baro-facts
Compiling rule: baro-ok-to-perform-baro-checks +j+j
+j+j
Compiling rule: baro-is-good-bfs =j+j+j+j+j
Compiling rule: baro-is-bad-bfs =j+j+j+j+j
Compiling rule: baro-is-good-pass =j=j=j+j+j+j+j
Compiling rule: baro-is-bad-pass =j=j=j+j+j+j+j
Compiling rule: baro-roll-reversal =j=j=j+j+j+j+j
Compiling rule: baro-crew-call =j+j+j+j
Compiling rule: baro-not-crew-call =j=j+j+j
Compiling rule: baro-enter-mach-jump =j+j+j+j
Compiling rule: baro-leave-mach-jump =j+j+j
Compiling rule: baro-filter-flag-changed =j+j+j+j+j
Compiling rule: baro-to-auto +j+j+j+j+j
Compiling rule: baro-end-force =j+j+j+j
Compiling rule: baro-to-inhibit +j+j+j+j
```

```
CLIPS> (reset)
f-0     (initial-fact)
f-1     (common-lru p-1-2 p-1-3 1)
f-2     (common-lru p-1-2 p-1-3 1)
f-3     (common-lru p-2-3 p-1-2 2)
f-4     (common-lru p-1-3 p-2-3 2)
f-5     (common-lru p-1-3 p-2-3 3)
f-6     (common-lru p-2-3 p-1-3 3)
f-7     (excluded-lru p-1-2 3)
f-8     (excluded-lru p-2-3 2)
f-9     (excluded-lru p-2-3 2)
f-10    (lrus-in-pair p-1-2 1 2)
f-11    (lrus-in-pair p-1-2 2 1)
f-12    (lrus-in-pair p-1-3 1 3)
f-13    (lrus-in-pair p-1-3 3 1)
f-14    (lrus-in-pair p-2-3 2 3)
f-15    (lrus-in-pair p-2-3 3 2)
f-16    (min-miscompare zero zero zero)
f-17    (min-miscompare under zero zero)
f-18    (min-miscompare o50 zero zero)
f-19    (min-miscompare over zero zero)
f-20    (min-miscompare zero under zero)
f-21    (min-miscompare under under under)
f-22    (min-miscompare o50 under under)
f-23    (min-miscompare over under under)
f-24    (min-miscompare zero o50 under)
f-25    (min-miscompare under o50 under)
f-26    (min-miscompare o50 o50 o50)
f-27    (min-miscompare over o50 o50)
f-28    (min-miscompare zero over zero)
f-29    (min-miscompare under over under)
f-30    (min-miscompare o50 over o50)
f-31    (min-miscompare over over over)
f-32    (max-miscompare zero zero zero)
f-33    (max-miscompare under zero under)
f-34    (max-miscompare o50 zero o50)
f-35    (max-miscompare over zero over)
f-36    (max-miscompare zero under under)
f-37    (max-miscompare under under under)
f-38    (max-miscompare o50 under o50)
f-39    (max-miscompare over under over)
f-40    (max-miscompare zero o50 o50)
f-41    (max-miscompare under o50 o50)
f-42    (max-miscompare o50 o50 o50)
f-43    (max-miscompare over o50 over)
f-44    (max-miscompare zero over over)
f-45    (max-miscompare under over over)
f-46    (max-miscompare o50 over over)
f-47    (max-miscompare over over over)
f-48    (fault-matrix o50 under under under good)
f-49    (fault-matrix o50 under under under velocity)
f-50    (fault-matrix o50 over under under velocity)
f-51    (fault-matrix o50 under under attitude)
f-52    (fault-matrix under under o50 attitude)
f-53    (fault-matrix under under o50 attitude)
f-54    (fault-matrix under over under over attitude)
```

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f-55  == ... ==>  (fault-matrix o50 o50 under resolver)
f-56  == ... ==>  (fault-matrix o50 o50 under resolver)
f-57  == ... ==>  (fault-matrix o50 over under resolver)
f-58  == ... ==>  (fault-matrix o50 over under resolver)
f-59  == ... ==>  (fault-matrix o50 under o50 bias)
f-60  == ... ==>  (fault-matrix o50 under over bias)
f-61  == ... ==>  (fault-matrix o50 under over bias)
f-62  == ... ==>  (fault-matrix o50 over under bias)
f-63  == ... ==>  (fault-matrix o50 under o50 drift)
f-64  == ... ==>  (fault-matrix o50 o50 drift)
f-65  == ... ==>  (fault-matrix o50 over o50 drift)
f-66  == ... ==>  (fault-matrix o50 over over drift)
f-67  == ... ==>  (fault-matrix o50 under over drift)
f-68  == ... ==>  (fault-matrix o50 o50 o50 suspect)
f-69  == ... ==>  (fault-matrix o50 over o50 suspect)
f-70  == ... ==>  (fault-matrix o50 over over o50 suspect)
f-71  == ... ==>  (fault-matrix o50 over over o50 suspect)
f-72  == ... ==>  (fault-matrix o50 over over suspect)
f-73  == ... ==>  (fault-matrix o50 over over suspect)
f-74  == ... ==>  (fault-matrix o50 over over suspect)
f-75  == ... ==>  (quality-table zero good)
f-76  == ... ==>  (quality-table under good)
f-77  == ... ==>  (quality-table o50 suspect)
f-78  == ... ==>  (quality-table o50 over bad)
f-79  == ... ==>  (tacan-quality under under under good)
f-80  == ... ==>  (tacan-quality under under over noise)
f-81  == ... ==>  (tacan-quality under o50 under bias)
f-82  == ... ==>  (tacan-quality under o50 over noise)
f-83  == ... ==>  (tacan-quality under over under bias)
f-84  == ... ==>  (tacan-quality under over over noise)
f-85  == ... ==>  (tacan-quality over under under timing)
f-86  == ... ==>  (tacan-quality over under over noise)
f-87  == ... ==>  (tacan-quality over over under timing)
f-88  == ... ==>  (tacan-quality over o50 under timing)
f-89  == ... ==>  (tacan-quality over over over noise)
f-90  == ... ==>  (msbls-quality under under good)
f-91  == ... ==>  (msbls-quality under under good)
f-92  == ... ==>  (msbls-quality under over good)
f-93  == ... ==>  (msbls-quality under over bad)
f-94  == ... ==>  (msbls-quality o50 under good)
f-95  == ... ==>  (msbls-quality o50 o50 good)
f-96  == ... ==>  (msbls-quality o50 over bad)
f-97  == ... ==>  (msbls-quality over under bad)
f-98  == ... ==>  (msbls-quality over o50 bad)
f-99  == ... ==>  (msbls-quality over over bad)
f-100 == ... ==>  (measurement-name tacr range)
f-101 == ... ==>  (measurement-name tacb bearing)
f-102 == ... ==>  (measurement-name msr range)
f-103 == ... ==>  (measurement-name msa azimuth)
f-104 == ... ==>  (measurement-name mise elevation)
f-105 == ... ==>  (units range feet)
f-106 == ... ==>  (units bearing degrees)
f-107 == ... ==>  (units azimuth degrees)
f-108 == ... ==>  (units elevation degrees)
f-109 == ... ==>  (units drag feet)
f-110 == ... ==>  (units tacr feet)
```

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==> f-111    (units baro feet)
==> f-112    (units msls feet)
==> f-113    (units tach degrees)
==> f-114    (units mlsa degrees)
==> f-115    (units mlse degrees)
==> f-116    (same-area 1 2)
==> f-117    (same-area 2 1)
==> f-118    (same-area 3 4)
==> f-119    (same-area 4 3)
==> f-120    (same-area 5 6)
==> f-121    (same-area 6 5)
==> f-122    (same-area 7 8)
==> f-123    (same-area 8 7)
==> f-124    (same-area 9 10)
==> f-125    (same-area 10 9)
==> f-126    (same-area 11 12)
==> f-127    (same-area 12 11)
==> f-128    (same-area 13 14)
==> f-129    (same-area 14 13)
==> f-130    (same-area 15 16)
==> f-131    (same-area 16 15)
==> f-132    (same-area 17 18)
==> f-133    (same-area 18 17)
==> f-134    (same-area 19 20)
==> f-135    (same-area 20 19)
==> f-136    (same-area 21 22)
==> f-137    (same-area 22 21)
==> f-138    (same-area 23 24)
==> f-139    (same-area 24 23)
==> f-140    (same-area 25 26)
==> f-141    (same-area 26 25)
==> f-142    (same-area 27 28)
==> f-143    (same-area 28 27)
==> f-144    (same-area 29 30)
==> f-145    (same-area 30 29)
==> Activation 0 (phase fact-assertion) f-145
==> f-146    (phase fact-assertion control-kickoff: f-146
==> Activation 1 (next-phase fact-assertion monitoring? f-147 f-146
==> f-147    (next phase control-change-phases: f-147 f-146
==> f-148    (next-phase monitoring analysis)
==> f-149    (next-phase analysis output)
==> f-150    (next-phase output fact-assertion)
==> f-151    (first-sub-phase baro monitoring quality)
==> f-152    (next-sub-phase baro quality flag-status)
==> f-153    (first-sub-phase baro analysis recommendations)
==> f-154    (baro-status unknown)
==> f-155    (prev-filter-flag Pass baro off)
==> f-156    (prev-filter-flag Bfs baro off)
CLIPS> (assert (single step))
CLIPS> (run)
FIRE 1 control-kickoff: f-146
FIRE 2 control-change-phases: f-147 f-146
==> f-146    (phase fact-assertion)
==> f-158    (phase monitoring)
==> Activation 2 control-kickoff-subphase: f-158 f-151
```

```
==> Activation    3 control-change-phases: f-148  f-159
FIRE  3 control-kickoff-subphase: f-159  f-151
==> f-159  (sub-phase baro quality)
==> Activation    4 control-last-subphase: f-159
==> Activation    5 control-next-subphase: f-159  f-152
FIRE  4 control-next-subphase: f-159  f-152
==> f-159  (sub-phase baro quality)
==> Activation    4 control-last-subphase: f-159
==> f-160 (sub-phase baro flag-status)
==> Activation  6 control-last-subphase: f-160
FIRE  5 control-last-subphase: f-160
==> f-160 (sub-phase baro flag-status): f-160
FIRE  6 control-change-phases: f-149  f-160
==> f-158  (phase monitoring)
==> f-161  (phase analysis)
==> Activation    7 control-kickoff-subphase: f-161  f-153
==> Activation    8 control-change-phase: f-149  f-161  f-161
FIRE  7 control-kickoff-subphase: f-161  f-153
==> f-162  (sub-phase baro recommendation)
==> Activation  9 control-last-subphase: f-162
FIRE  8 control-last-subphase: f-162
==> f-162  (sub-phase baro recommendation)
FIRE  9 control-change-phases: f-149  f-161
==> f-161  (phase analysis)
==> f-163  (phase output)
==> Activation 10 control-change-phases: f-150  f-163
==> Activation 11 control-end-of-cycle: f-157  f-163
FIRE 10 control-end-of-cycle: f-157  f-163
10 rules fired
Run time is 2500 seconds
(CLIPS) (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: baro-ok-to-perform-baro-checks
Excising rule: baro-is-good-bfs
Excising rule: baro-is-bad-bfs
Excising rule: baro-is-good-pass
Excising rule: baro-is-bad-pass
Excising rule: baro-roll-reversal
Excising rule: baro-crew-call
Excising rule: baro-not-crew-call
Excising rule: baro-enter-mach-jump
Excising rule: baro-leave-mach-jump
Excising rule: baro-filter-flag-changed
Excising rule: baro-to-auto
Excising rule: baro-to-force
Excising rule: baro-end-force
Excising rule: baro-to-inhibit
(CLIPS) (load "Dan/tables")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
```

```
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-mstls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "Dan/drag.r")
Processing deffacts block: monitoring-drag-phases
Processing deffacts block: analysis-drag-phases
Processing deffacts block: initial-drag-facts
Compiling rule: drag-filter-flag-changed +j+j+j+j
Compiling rule: drag-end-drag-processing =j=j+j+j+j
=j=j=j+j+j
Compiling rule: drag-force +j+j+j+j+j+j
Compiling rule: drag-auto =j=j+j+j+j+j
Compiling rule: drag-inhibit =j=j+j+j
CLIPS> (reset)

==> f-0    (initial-fact)
==> f-1    (common-iru p-1-2 p-1-3 1-3)
==> f-2    (common-iru p-1-3 p-1-2 1-2)
==> f-3    (common-iru p-2-3 p-1-2 1-2)
==> f-4    (common-iru p-1-2 p-2-3 2-3)
==> f-5    (common-iru p-1-3 p-2-3 2-3)
==> f-6    (common-iru p-2-3 p-1-3 1-3)
==> f-7    (excluded-iru p-1-2 1-2)
==> f-8    (excluded-iru p-2-3 2-3)
==> f-9    (irus-in-pair p-2-3 2)
==> f-10   (irus-in-pair p-1-2 2)
==> f-11   (irus-in-pair p-1-3 2)
==> f-12   (irus-in-pair p-2-3 3)
==> f-13   (irus-in-pair p-1-3 3)
==> f-14   (irus-in-pair p-2-3 2)
==> f-15   (min-miscompare zero zero zero)
==> f-16   (min-miscompare under zero zero zero)
==> f-17   (min-miscompare o50 zero zero)
==> f-18   (min-miscompare over zero zero)
==> f-19   (min-miscompare zero under zero)
==> f-20   (min-miscompare under under under)
==> f-21   (min-miscompare o50 under under)
==> f-22   (min-miscompare over under under)
==> f-23   (min-miscompare zero o50 zero)
==> f-24   (min-miscompare under o50 under)
==> f-25   (min-miscompare o50 o50 o50)
```

```
(min-miscompare over o50 o50)
(min-miscompare zero over zero)
(min-miscompare under over zero)
(min-miscompare o50 over o50)
(min-miscompare over over zero)
(max-miscompare zero zero zero)
(max-miscompare under zero under)
(max-miscompare o50 zero o50)
(max-miscompare over zero over)
(max-miscompare zero under under)
(max-miscompare under under under)
(max-miscompare o50 under o50)
(max-miscompare over under over)
(max-miscompare zero o50 o50)
(max-miscompare under o50 o50)
(max-miscompare o50 o50 o50)
(max-miscompare over o50 over)
(max-miscompare zero over over)
(max-miscompare under over over)
(max-miscompare o50 over over)
(max-miscompare over over over)
(fault-matrix under o50 under under good)
(fault-matrix o50 under under under velocity)
(fault-matrix over under under velocity)
(fault-matrix under o50 under attitude)
(fault-matrix over under over attitude)
(fault-matrix under under o50 attitude)
(fault-matrix under o50 over attitude)
(fault-matrix o50 under over resolver)
(fault-matrix over o50 under resolver)
(fault-matrix o50 over under resolver)
(fault-matrix over over under resolver)
(fault-matrix under o50 bias)
(fault-matrix o50 under over o50 bias)
(fault-matrix over under over bias)
(fault-matrix under o50 over bias)
(fault-matrix o50 o50 drift)
(fault-matrix over o50 over o50 drift)
(fault-matrix under over o50 drift)
(fault-matrix o50 over o50 over drift)
(fault-matrix over o50 over over drift)
(fault-matrix under over over drift)
(fault-matrix o50 o50 o50 suspect)
(fault-matrix over o50 over o50 suspect)
(fault-matrix under over o50 suspect)
(fault-matrix o50 over o50 over suspect)
(fault-matrix over o50 over over suspect)
(fault-matrix over over over suspect)
(quality-table zero good)
(quality-table under good)
(quality-table o50 suspect)
(quality-table over bad)
(tacan-quality under under good)
(tacan-quality under under over noise)
(tacan-quality under o50 under bias)
(tacan-quality under o50 over noise)
```

```
f-83   (tacan-quality under over under bias)
f-84   (tacan-quality under over over noise)
f-85   (tacan-quality under over under timing)
f-86   (tacan-quality over under over noise)
f-87   (tacan-quality over 050 under timing)
f-88   (tacan-quality over 050 over noise)
f-89   (tacan-quality over over under timing)
f-90   (tacan-quality over over over noise)
f-91   (msbls-quality under under good)
f-92   (msbls-quality under over good)
f-93   (msbls-quality under over 050 good)
f-94   (msbls-quality 050 under good)
f-95   (msbls-quality 050 050 good)
f-96   (msbls-quality 050 over good)
f-97   (msbls-quality 050 over under bad)
f-98   (msbls-quality over under 050 bad)
f-99   (msbls-quality over over bad)
f-100  (measurement-name tacr range)
f-101  (measurement-name tacb bearing)
f-102  (measurement-name mlsr range)
f-103  (measurement-name mlsa azimuth)
f-104  (measurement-name mlse elevation)
f-105  (units range feet)
f-106  (units bearing degrees)
f-107  (units azimuth degrees)
f-108  (units elevation degrees)
f-109  (units drag feet)
f-110  (units tacr feet)
f-111  (units baro feet)
f-112  (units mlsr feet)
f-113  (units tacb degrees)
f-114  (units mlsa degrees)
f-115  (units mlse degrees)
f-116  (same-area 2)
f-117  (same-area 3)
f-118  (same-area 4)
f-119  (same-area 5)
f-120  (same-area 6)
f-121  (same-area 7)
f-122  (same-area 8)
f-123  (same-area 9)
f-124  (same-area 10)
f-125  (same-area 11)
f-126  (same-area 12)
f-127  (same-area 13)
f-128  (same-area 14)
f-129  (same-area 15)
f-130  (same-area 16)
f-131  (same-area 17)
f-132  (same-area 18)
f-133  (same-area 19)
f-134  (same-area 20)
f-135  (same-area 21)
f-136  (same-area 22)
f-137  (same-area 23)
f-138  (same-area 24)
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```
==> f-139    (same-area 24 23)
==> f-140    (same-area 25 26)
==> f-141    (same-area 26 25)
==> f-142    (same-area 27 28)
==> f-143    (same-area 28 27)
==> f-144    (same-area 29 30)
==> f-145    (same-area 30 29)
==> f-146    (phase fact-assertion)
==> Activation 0 control-kickoff: f-146
==> f-147    (next-phase fact-assertion monitoring)
==> Activation 1 control-change-phase: f-147 f-146
==> f-148    (phase monitoring)
==> Activation 1 control-monitoring)
==> f-149    (next-phase monitoring analysis)
==> f-150    (next-phase analysis output)
==> f-151    (next-phase output fact-assertion)
==> f-152    (first-sub-phase drag monitoring watch-flags)
==> f-153    (first-sub-phase drag analysis recommendation)
==> f-154    (prev-filter-flag pass drag process)
==> f-154    (prev-filter-flag bfs drag process)
CLIPS> (assert (single step))
==> f-155    (single step)
CLIPS> (run)
FIRE  1 control-kickoff: f-146
FIRE  2 control-change-phases: f-147 f-146
<== f-146    (phase fact-assertion)
==> f-156    (phase monitoring)
==> Activation 3 control-kickoff-subphase: f-156 f-151
==> Activation 3 control-change-phase: f-148 f-151
FIRE  3 control-kickoff-subphase: f-156 f-151
<== f-157    (sub-phase drag watch-flags)
==> Activation 4 control-last-subphase: f-157
FIRE  4 control-last-subphase: f-157
<== f-157    (sub-phase drag watch-flags)
FIRE  5 control-change-phases: f-148 f-156
<== f-156    (phase monitoring)
==> f-158    (phase analysis)
==> Activation 5 control-kickoff-subphase: f-158 f-152
==> Activation 6 control-change-phase: f-149 f-152
FIRE  6 control-kickoff-subphase: f-158 f-152
<== f-159    (sub-phase drag recommendation) f-159
==> Activation 7 control-last-subphase: f-159
FIRE  7 control-last-subphase: f-159
<== f-159    (sub-phase drag recommendation)
FIRE  8 control-change-phases: f-149 f-158
<== f-158    (phase analysis)
==> f-160    (phase output)
==> Activation 8 control-change-phases: f-150 f-160
==> Activation 9 control-end-of-cycle: f-155 f-160
FIRE  9 control-end-of-cycle: f-155 f-160
9 rules fired
Run time is 1.2400 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
```

```
Excising rule: control-last-subphase
Excising rule: drag-filter-flag-changed
Excising rule: drag-end-drag-processing
Excising rule: drag-force
Excising rule: drag-auto
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "Dan/hstd.r")
Processing deffacts block: monitoring-hstd-phases
Processing deffacts block: initial-hstd-facts
Compiling rule: hstd-start +j+j+j
Compiling rule: hstd-bad =j+j+j
Compiling rule: hstd-good =j+j+j+j
Compiling rule: hstd-stopped =j+j+j
Compiling rule: hstd-editing =j=j+j+j+j+j+j
=j=j+j+j+j+j
Compiling rule: hstd-prop =j=j+j
Compiling rule: hstd-covariance =j=j+j+j
Compiling rule: hstd-restart =j+j+j+j+j
CLIPS> (reset)

==> f-0  (initial-fact)
==> f-1  (common-lru p-1-1 p-1-3 1)
==> f-2  (common-lru p-1-2 p-1-2 1)
==> f-3  (common-lru p-2-1 p-1-2 2)
==> f-4  (common-lru p-1-3 p-2-3 3)
==> f-5  (common-lru p-1-3 p-2-3 3)
==> f-6  (common-lru p-2-3 p-1-3 3)
==> f-7  (excluded-lru p-1-2 3)
==> f-8  (excluded-lru p-1-2 3)
==> f-9  (excluded-lru p-2-3 2)
==> f-10 (lrus-in-pair p-1-2 2)
==> f-11 (lrus-in-pair p-1-2 1)
==> f-12 (lrus-in-pair p-1-3 3)
==> f-13 (lrus-in-pair p-1-3 3)
==> f-14 (lrus-in-pair p-2-3 2 3)
```

```
f-15    (lrus-in-pair p-2-3 3 2)                           ^  =
f-16    (min-miscompare zero zero zero)                    ^  =
f-17    (min-miscompare under zero zero)                   ^  =
f-18    (min-miscompare 050 zero zero)                     ^  =
f-19    (min-miscompare over zero zero)                    ^  =
f-20    (min-miscompare zero under zero)                   ^  =
f-21    (min-miscompare under under under)                 ^  =
f-22    (min-miscompare 050 under under)                   ^  =
f-23    (min-miscompare over under under)                  ^  =
f-24    (min-miscompare zero 050 zero)                     ^  =
f-25    (min-miscompare under 050 under)                   ^  =
f-26    (min-miscompare 050 050 050)                       ^  =
f-27    (min-miscompare over 050 050)                      ^  =
f-28    (min-miscompare zero over zero)                    ^  =
f-29    (min-miscompare under over under)                  ^  =
f-30    (min-miscompare 050 over 050)                      ^  =
f-31    (min-miscompare over over over)                    ^  =
f-32    (max-miscompare zero zero zero)                    ^  =
f-33    (max-miscompare under zero under)                  ^  =
f-34    (max-miscompare 050 zero 050)                      ^  =
f-35    (max-miscompare over zero over)                    ^  =
f-36    (max-miscompare zero under under)                  ^  =
f-37    (max-miscompare under under under)                 ^  =
f-38    (max-miscompare 050 under 050)                     ^  =
f-39    (max-miscompare over under over)                   ^  =
f-40    (max-miscompare zero 050 050)                      ^  =
f-41    (max-miscompare under 050 050)                     ^  =
f-42    (max-miscompare 050 050 050)                       ^  =
f-43    (max-miscompare over 050 over)                     ^  =
f-44    (max-miscompare zero over over)                    ^  =
f-45    (max-miscompare under over over)                   ^  =
f-46    (max-miscompare 050 over over)                     ^  =
f-47    (max-miscompare over over over)                    ^  =
f-48    (fault-matrix under under under good)              ^  =
f-49    (fault-matrix 050 under under velocity)            ^  =
f-50    (fault-matrix over under under velocity)           ^  =
f-51    (fault-matrix under 050 under attitude)            ^  =
f-52    (fault-matrix over under under attitude)           ^  =
f-53    (fault-matrix under under 050 attitude)            ^  =
f-54    (fault-matrix under under over attitude)           ^  =
f-55    (fault-matrix 050 050 under resolver)              ^  =
f-56    (fault-matrix over 050 under resolver)             ^  =
f-57    (fault-matrix 050 over under resolver)             ^  =
f-58    (fault-matrix over over under resolver)            ^  =
f-59    (fault-matrix 050 under 050 bias)                  ^  =
f-60    (fault-matrix over under 050 bias)                 ^  =
f-61    (fault-matrix 050 under over bias)                 ^  =
f-62    (fault-matrix over under over bias)                ^  =
f-63    (fault-matrix under 050 050 drift)                 ^  =
f-64    (fault-matrix under over 050 drift)                ^  =
f-65    (fault-matrix under 050 over drift)                ^  =
f-66    (fault-matrix under over over drift)               ^  =
f-67    (fault-matrix 050 050 050 suspect)                 ^  =
f-68    (fault-matrix over 050 050 suspect)                ^  =
f-69    (fault-matrix 050 over 050 suspect)                ^  =
f-70    (fault-matrix over over 050 suspect)               ^  =
```

```
(fault-matrix 050 050 over suspect)
(fault-matrix over 050 over suspect)
(fault-matrix 050 over over suspect)
(fault-matrix over over over suspect)
(quality-table zero good)
(quality-table under good)
(quality-table 050 suspect)
(quality-table 050 over bad)
(tacan-quality under under under good)
(tacan-quality under under over noise)
(tacan-quality under 050 under bias)
(tacan-quality under 050 over noise)
(tacan-quality under over under bias)
(tacan-quality under over over noise)
(tacan-quality over under under timing)
(tacan-quality over under over noise)
(tacan-quality over 050 under timing)
(tacan-quality over 050 over noise)
(tacan-quality over over under timing)
(tacan-quality over over over noise)
(msbls-quality under under good)
(msbls-quality under over bad)
(msbls-quality under 050 over good)
(msbls-quality 050 under good)
(msbls-quality 050 050 good)
(msbls-quality 050 over bad)
(msbls-quality over under bad)
(msbls-quality over 050 bad)
(msbls-quality over over bad)
(measurement-name tacp range)
(measurement-name tacb bearing)
(measurement-name mlsr range)
(measurement-name mlsa azimuth)
(measurement-name mlse elevation)
(units range feet)
(units bearing degrees)
(units azimuth degrees)
(units elevation degrees)
(units drag feet)
(units tacr feet)
(units baro feet)
(units mlsr feet)
(units tacb degrees)
(units mlsa degrees)
(units mlse degrees)
(same-area 1 2)
(same-area 2 1)
(same-area 4 3)
(same-area 5 6)
(same-area 7 8)
(same-area 8 7)
(same-area 9 10)
(same-area 10 19)
(same-area 11 12)
```

```
==> f-127   (same-area 12 11)
==> f-128   (same-area 13 14)
==> f-129   (same-area 14 17)
==> f-130   (same-area 15 16)
==> f-131   (same-area 16 15)
==> f-132   (same-area 17 10)
==> f-133   (same-area 18 17)
==> f-134   (same-area 19 20)
==> f-135   (same-area 20 19)
==> f-136   (same-area 21 22)
==> f-137   (same-area 22 21)
==> f-138   (same-area 23 24)
==> f-139   (same-area 24 23)
==> f-140   (same-area 25 26)
==> f-141   (same-area 26 25)
==> f-142   (same-area 27 28)
==> f-143   (same-area 28 27)
==> f-144   (same-area 29 30)
==> f-145   (same-area 30 29)
==> f-146   (phase fact-assertion)
==> Activation  0 control-kickoff: f-146
==> f-147   (next-phase fact-assertion monitoring)
==> Activation  1 control-change-phases: f-147  f-146
==> f-148   (next-phase monitoring analysis)
==> f-149   (next-phase analysis output)
==> f-150   (next-phase output fact-assertion)
==> f-151   (first-sub-phase hstd monitoring status)
==> f-152   (hstd stopped)
==> f-153   (restart-time 0)
CLIPS> (assert (single step))
==> f-154   (single step)
CLIPS> (run)
FIRE  1 control-kickoff:  f-146
FIRE  2 control-change-phases:  f-147  f-146
==> f-146   (phase fact-assertion)
==> f-155   (phase monitoring)
==> Activation  2 control-kickoff-subphase:  f-155  f-151
==> Activation  3 control-kickoff-subphase:  f-155  f-148
FIRE  3 control-kickoff-subphase:  f-155  f-151
==> f-156   (sub-phase hstd status)
==> Activation  4 control-last-subphase:  f-156
FIRE  4 control-last-subphase:  f-156
==> f-155   (sub-phase hstd status)
==> Activation  5 control-change-phases:  f-148  f-155
==> f-155   (phase monitoring)
==> f-157   (phase analysis)
==> Activation  6 control-change-phases:  f-149  f-157
FIRE  5 control-change-phases:  f-149  f-157
==> f-157   (phase analysis)
==> f-158   (phase output)
==> Activation  6 control-change-phases:  f-150  f-158
==> Activation  7 control-end-of-cycle:  f-154  f-158
FIRE  6 control-change-phases:  f-150  f-158
FIRE  7 control-end-of-cycle:  f-154  f-158
7 rules fired
Run time is 0.5000 seconds
CLIPS> (clear)
```

```
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: hstd-start
Excising rule: hstd-bad
Excising rule: hstd-good
Excising rule: hstd-stopped
Excising rule: hstd-editing
Excising rule: hstd-prop
Excising rule: hstd-covariance
Excising rule: hstd-restart
CLIPS>(load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS>(load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS>(load "Dan/imu.r")
Processing deffacts block: monitoring-imu-phases
Processing deffacts block: analysis-imu-phases
Processing deffacts block: initial-imu-facts
Compiling rule: imu-comfault-pass +j+j+j+j+j
Compiling rule: imu-comf-clear-pass +j+j+j+j+j+j
Compiling rule: imu-comf-clear-pass-2 +j+j+j+j+j+j
Compiling rule: imu-failed-pass +j=j+j+j+j+j+j
Compiling rule: imu-deselected-pass +j=j+j+j+j+j
Compiling rule: imu-reselected-pass +j=j+j+j+j+j+j+j
Compiling rule: three-good-imus =j=j+j+j+j+j+j
Compiling rule: two-good-imus =j=j+j+j+j+j+j
=j=j+j+j
Compiling rule: one-good-imu =j=j+j+j+j+j
=j=j+j
+j=j+j
Compiling rule: no-good-imu =j=j+j+j+j+j
=j=j+j
+j=j+j
=j=j+j
```

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```
Compiling rule: imu-comfault-bfs
Compiling rule: imu-comf-clear-bfs-not-engaged
Compiling rule: imu-comf-clear-bfs-engaged-part1
Compiling rule: imu-comf-clear-bfs-engaged-part2
Compiling rule: imu-failed-bfs
Compiling rule: imu-deselected-bfs-1-not-engaged
Compiling rule: imu-deselected-bfs-2-not-engaged
Compiling rule: imu-deselected-bfs-engaged
Compiling rule: imu-result-bfs-engaged
Compiling rule: imu-change-bfs
Compiling rule: valid-velocity
Compiling rule: invalid-velocity

Compiling rule: valid-attitude
Compiling rule: invalid-attitude

Compiling rule: valid-to-use-acc-comparison
Compiling rule: valid-acc
Compiling rule: invalid-acc

Compiling rule: velocity-comparison-1
Compiling rule: velocity-comparison-2
Compiling rule: attitude-comparison-1
Compiling rule: attitude-comparison-2
Compiling rule: acc-comparison-1
Compiling rule: acc-comparison-2
Compiling rule: worst-comparison
Compiling rule: three-level-component-isolation
Compiling rule: two-level-gnd-comparison
Compiling rule: two-level-gnd-cant-vote
Compiling rule: two-level-state-comparison
Compiling rule: two-level-state-cant-vote

Compiling rule: two-level-acc-comparison
Compiling rule: two-level-acc-cant-vote
Compiling rule: partial-imu-velocity
Compiling rule: partial-imu-attitude
Compiling rule: partial-imu-acc
Compiling rule: partial-imu-cant-vote
Compiling rule: two-level-vote-count
Compiling rule: two-level-imu-isolation
Compiling rule: two-level-component-isolation
Compiling rule: two-level-cant-isolate
Compiling rule: two-level-vote-cleanup
Compiling rule: change-imu-quality
Compiling rule: imu-status-light
Compiling rule: bias-magnitude
Compiling rule: resolver-magnitude
Compiling rule: initial-misalignment
```

```
=j=j=j=j+j+j
Compiling rule: drift-magnitude =j=j+j+j+j+j+j+j
Compiling rule: three-level-failure-prediction +j+j+j+j+j+j+j
Compiling rule: three-level-no-failure-prediction =j=j+j+j+j+j+j
Compiling rule: two-level-failure-prediction =j+j+j+j+j+j+j+j
Compiling rule: reselect-imu-with-one-or-three-or-three-state-nav =j+j+j+j+j
Compiling rule: help-imu-dilemma =j+j+j+j+j+j
Compiling rule: cant-help-imu-dilemma =j=j=j+j+j+j+j
Compiling rule: end-imu-dilemma =j+j+j
Compiling rule: incorrect-imu-failure =j+j+j+j+j
Compiling rule: deselect-comfaulted-imu =j+j+j
Compiling rule: deselect-imu-in-bfs +j+j+j+j+j
Compiling rule: no-bfs-imus =j+j+j+j+j+j+j
Compiling rule: change-bfs-imu-y =j=j+j+j+j+j+j
=j=j=j=j+j+j
Compiling rule: change-bfs-imu-2 =j=j+j+j+j+j+j+j
CLIPS> (reset)
==> f-0    (initial-fact)
==> f-1    (common-imu p-1-2 p-1-3 1)
==> f-2    (common-imu p-2-3 p-1-2 2)
==> f-3    (common-imu p-1-1 p-2-3 2)
==> f-4    (common-imu p-1-2 p-2-3 3)
==> f-5    (common-imu p-1-2 p-2-3 3)
==> f-6    (excluded-imu p-1-2 3)
==> f-7    (excluded-imu p-1-3 2)
==> f-8    (excluded-imu p-2-3 2)
==> f-9    (imus-in-pair p-1-2 2)
==> f-10   (imus-in-pair p-1-2 2-1)
==> f-11   (imus-in-pair p-1-3 2)
==> f-12   (imus-in-pair p-1-3 3-1)
==> f-13   (imus-in-pair p-2-3 3-2)
==> f-14   (min-miscompare zero zero zero)
==> f-15   (min-miscompare under zero zero)
==> f-16   (min-miscompare under zero zero)
==> f-17   (min-miscompare 050 zero zero)
==> f-18   (min-miscompare zero over zero)
==> f-19   (min-miscompare zero under zero)
==> f-20   (min-miscompare zero under under)
==> f-21   (min-miscompare 050 under under)
==> f-22   (min-miscompare zero under under)
==> f-23   (min-miscompare zero 050 zero)
==> f-24   (min-miscompare under 050 zero)
==> f-25   (min-miscompare under 050 under)
==> f-26   (min-miscompare 050 050 050)
==> f-27   (min-miscompare zero over 050)
==> f-28   (min-miscompare zero over zero)
==> f-29   (min-miscompare under over under)
==> f-30   (min-miscompare 050 over 050)
==> f-31   (min-miscompare zero over over)
==> f-32   (max-miscompare zero zero zero)
==> f-33   (max-miscompare zero zero zero)
==> f-34   (max-miscompare 050 zero 050)
==> f-35   (max-miscompare zero over over)
==> f-36   (max-miscompare zero under under)
```

```
f-37  (max-miscompare under under under )
f-38  (max-miscompare o50 under o50 )
f-39  (max-miscompare over under over )
f-40  (max-miscompare zero under over )
f-41  (max-miscompare under o50 o50 )
f-42  (max-miscompare o50 o50 o50 )
f-43  (max-miscompare over o50 over )
f-44  (max-miscompare zero over over )
f-45  (max-miscompare under over over )
f-46  (max-miscompare o50 over over )
f-47  (max-miscompare over over over )
f-48  (fault-matrix under under under good )
f-49  (fault-matrix o50 under under velocity )
f-50  (fault-matrix over under under velocity )
f-51  (fault-matrix under o50 under attitude )
f-52  (fault-matrix under over under attitude )
f-53  (fault-matrix under o50 o50 attitude )
f-54  (fault-matrix under over o50 attitude )
f-55  (fault-matrix o50 o50 under resolver )
f-56  (fault-matrix over o50 under resolver )
f-57  (fault-matrix o50 over under resolver )
f-58  (fault-matrix over over under resolver )
f-59  (fault-matrix o50 under o50 bias )
f-60  (fault-matrix over under o50 bias )
f-61  (fault-matrix o50 under over bias )
f-62  (fault-matrix over under over bias )
f-63  (fault-matrix under o50 o50 drift )
f-64  (fault-matrix under over o50 drift )
f-65  (fault-matrix under o50 over drift )
f-66  (fault-matrix under over over drift )
f-67  (fault-matrix o50 o50 o50 suspect )
f-68  (fault-matrix over o50 o50 suspect )
f-69  (fault-matrix o50 over o50 suspect )
f-70  (fault-matrix over over o50 suspect )
f-71  (fault-matrix o50 o50 over suspect )
f-72  (fault-matrix over o50 over suspect )
f-73  (fault-matrix o50 over over suspect )
f-74  (fault-matrix over over over suspect )
f-75  (quality-table zero good )
f-76  (quality-table under good )
f-77  (quality-table o50 suspect )
f-78  (quality-table over bad )
f-79  (tacan-quality under under good )
f-80  (tacan-quality under over noise )
f-81  (tacan-quality under o50 noise )
f-82  (tacan-quality o50 over noise )
f-83  (tacan-quality under under bias )
f-84  (tacan-quality over over noise )
f-85  (tacan-quality under under timing )
f-86  (tacan-quality over over timing )
f-87  (tacan-quality o50 under timing )
f-88  (tacan-quality over over noise )
f-89  (tacan-quality over under timing )
f-90  (tacan-quality over over noise )
f-91  (msbls-quality under under good )
f-92  (msbls-quality under o50 good )
```

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== f-93   ^ == (msbls-quality under over bad)
== f-94   ^ == (msbls-quality 050 under good)
== f-95   ^ == (msbls-quality 050 050 good)
== f-96   ^ == (msbls-quality 050 over bad)
== f-97   ^ == (msbls-quality over under bad)
== f-98   ^ == (msbls-quality over under bad)
== f-99   ^ == (msbls-quality over 050 bad)
== f-100  ^ == (measurement-name tacr range)
== f-101  ^ == (measurement-name tacb bearing)
== f-102  ^ == (measurement-name misr range)
== f-103  ^ == (measurement-name misa azimuth)
== f-104  ^ == (measurement-name mise elevation)
== f-105  ^ == (units range feet)
== f-106  ^ == (units bearing degrees)
== f-107  ^ == (units azimuth degrees)
== f-108  ^ == (units elevation degrees)
== f-109  ^ == (units drag feet)
== f-110  ^ == (units tacr feet)
== f-111  ^ == (units baro feet)
== f-112  ^ == (units misr feet)
== f-113  ^ == (units tacb degrees)
== f-114  ^ == (units misa degrees)
== f-115  ^ == (units mise degrees)
== f-116  ^ == (same-area 1 2)
== f-117  ^ == (same-area 2 1)
== f-118  ^ == (same-area 3 4)
== f-119  ^ == (same-area 4 3)
== f-120  ^ == (same-area 5 6)
== f-121  ^ == (same-area 6 5)
== f-122  ^ == (same-area 7 8)
== f-123  ^ == (same-area 8 7)
== f-124  ^ == (same-area 9 10)
== f-125  ^ == (same-area 10 9)
== f-126  ^ == (same-area 11 12)
== f-127  ^ == (same-area 12 11)
== f-128  ^ == (same-area 13 14)
== f-129  ^ == (same-area 14 13)
== f-130  ^ == (same-area 15 16)
== f-131  ^ == (same-area 16 15)
== f-132  ^ == (same-area 17 18)
== f-133  ^ == (same-area 18 17)
== f-134  ^ == (same-area 19 20)
== f-135  ^ == (same-area 20 19)
== f-136  ^ == (same-area 21 22)
== f-137  ^ == (same-area 22 21)
== f-138  ^ == (same-area 23 24)
== f-139  ^ == (same-area 24 23)
== f-140  ^ == (same-area 25 26)
== f-141  ^ == (same-area 26 25)
== f-142  ^ == (same-area 27 28)
== f-143  ^ == (same-area 28 27)
== f-144  ^ == (same-area 29 30)
== f-145  ^ == (same-area 30 29)
== f-146  ^ == (phase fact-assertion)
Activation 0 control-kickoff; f-146
== f-147  ^ == (next-phase fact-assertion monitoring)
```

```
==> Activation 1 control-change-phases: f-147 f-146
==  f-148  (next-phase monitoring analysis)
==  f-149  (next-phase analysis output)
==  f-150  (next-phase analysis output)
==  f-151  (first-sub-phase imu monitoring pass-availability)
==  f-152  (next-sub-phase imu pass-availability bfs-availability)
==  f-153  (next-sub-phase imu bfs-availability error-detection)
==  f-154  (next-sub-phase imu error-detection error-isolation)
==  f-155  (next-sub-phase imu error-isolation error-magnitude)
==  f-156  (next-sub-phase imu error-magnitude failure-prediction)
==  f-157  (first-sub-phase imu analysis pass-recommendation)
==  f-158  (next-sub-phase imu analysis pass-recommendation bfs-recommendation)
==  f-159  (imu-avail-output pass 1 avail)
==  f-160  (imu-avail-output pass 2 avail)
==  f-161  (imu-avail-output pass 3 avail)
==  f-162  (imu-avail-output bfs 1 avail)
==  f-163  (imu-avail-output bfs 2 avail)
==  f-164  (imu-avail-output bfs 3 avail)
==  f-165  (good-imus 3)
==  f-166  (prev-bfs-imu 0)
==  f-167  (is-imu-valid 1 vel valid)
==  f-168  (is-imu-valid 2 vel valid)
==  f-169  (is-imu-valid 3 vel valid)
==  f-170  (is-imu-valid 1 att valid)
==  f-171  (is-imu-valid 2 att valid)
==  f-172  (is-imu-valid 3 att valid)
==  f-173  (is-imu-valid 1 acc invalid)
==  f-174  (is-imu-valid 2 acc invalid)
==  f-175  (is-imu-valid 3 acc invalid)
==  f-176  (imu-quality 1 good)
==  f-177  (imu-quality 2 good)
==  f-178  (imu-quality 3 good)
==  f-179  (imu-vel 1 under)
==  f-180  (imu-vel 2 under)
==  f-181  (imu-vel 3 under)
==  f-182  (imu-att 1 under)
==  f-183  (imu-att 2 under)
==  f-184  (imu-att 3 under)
==  f-185  (imu-acc 1 under)
==  f-186  (imu-acc 2 under)
==  f-187  (imu-acc 3 under)
==  f-188  (imu-rm-prediction none)
==  f-189  (initial-misalignment 1 unknown)
==  f-190  (initial-misalignment 2 unknown)
==  f-191  (initial-misalignment 3 unknown)
CLIPS> (assert (single-step))
==> f-192 (single-step)
CLIPS> (run)
FIRE 1 control-kickoff: f-146
FIRE 2 control-change-phases: f-147 f-146
==  f-146  (phase fact-assertion)
==  f-193  (phase monitoring)
==> Activation 2 control-kickoff-subphase: f-192 f-151
==> Activation 3 control-change-phases: f-148 f-193
FIRE 3 control-kickoff-subphase: f-193 f-151
==  f-194  (sub-phase imu pass-availability)
```

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==> Activation    4  control-last-subphase: f-194
==> Activation    5  control-next-subphase: f-194  f-152
FIRE    4  control-next-subphase: f-194  f-152
=== f-194  (sub-phase imu pass-availability)
==> f-195  (sub-phase imu bfs-availability)
==> Activation    6  control-last-subphase: f-195
==> Activation    7  control-next-subphase: f-195  f-153
FIRE    5  control-next-subphase: f-195  f-153
=== f-195  (sub-phase imu bfs-availability)
=== Activation    6  control-last-subphase: f-195
=== Activation    7  (sub-phase imu error-detection)
=== Activation    8  control-last-subphase: f-196
==> Activation    9  control-next-subphase: f-196  f-154
FIRE    6  control-next-subphase: f-196  f-154
=== f-196  (sub-phase imu error-detection)
=== Activation    8  control-last-subphase: f-196
=== f-197  (sub-phase imu error-isolation)
=== Activation   10  control-last-subphase: f-197
=== Activation   11  control-next-subphase: f-197  f-155
=== Activation   12  imu-status-light: f-197  f-164
=== Activation   13  imu-status-light: f-197  f-163
=== Activation   14  imu-status-light: f-197  f-162
=== Activation   15  imu-status-light: f-197  f-161
=== Activation   16  imu-status-light: f-197  f-160
=== Activation   17  imu-status-light: f-197  f-159
FIRE    7  imu-status-light: f-197  f-159  f-176
=== f-198  (status-light pass-imu 1 good)
FIRE    8  imu-status-light: f-197  f-160  f-177
=== f-199  (status-light pass-imu 2 good)
FIRE    9  imu-status-light: f-197  f-161  f-178
=== f-200  (status-light pass-imu 3 good)
FIRE   10  imu-status-light: f-197  f-162  f-176
=== f-201  (status-light bfs-imu 1 good)
FIRE   11  imu-status-light: f-197  f-163  f-177
=== f-202  (status-light bfs-imu 2 good)
FIRE   12  imu-status-light: f-197  f-164  f-178
==> f-203  (status-light bfs-imu 3 good)
FIRE   13  control-next-subphase: f-197  f-155
=== f-197  (sub-phase imu error-isolation)
=== Activation   10  control-last-subphase: f-197
=== f-204  (sub-phase imu error-magnitude)
=== Activation   18  control-last-subphase: f-204
=== Activation   19  control-next-subphase: f-204  f-156
FIRE   14  control-next-subphase: f-204  f-156
=== f-204  (sub-phase imu error-magnitude)
=== Activation   18  control-last-subphase: f-204
=== Activation   20  control-last-subphase: f-205
FIRE   15  control-last-subphase: f-205
=== f-205  (sub-phase imu failure-prediction)
=== f-16  control-change-phases: f-206  f-157
=== f-193  (phase monitoring)
=== f-206  (phase analysis)
=== Activation   21  control-kickoff-subphase: f-149  f-193
==> Activation   22  control-change-phases: f-206
```

FIRE   17 control-kickoff-subphase: f-206 f-157
==> f-207 (sub-phase imu-pass-recommendation)
==> Activation 23 control-last-subphase: f-207
==> Activation 24 control-next-subphase: f-207 f-158   f-158
FIRE   18 control-next-subphase: f-207 f-158
==> f-207 (sub-phase imu-pass-recommendation)
==> Activation 23 control-last-subphase: f-207
==> f-208 (sub-phase imu bfs-recommendation)
==> Activation 25 control-last-subphase: f-208
FIRE   19 control-last-subphase: f-208
==> f-208 (sub-phase imu bfs-recommendation)
FIRE   20 control-change-phases: f-149 f-206
==> f-206 (phase analysis)
==> f-209 (phase output)
==> Activation 26 control-change-phases: f-150   f-209
==> Activation 27 control-end-of-cycle: f-192 f-209
FIRE   21 control-end-of-cycle: f-192 f-209
21 rules fired

Run time is 7.7500 seconds
(CLIPS> (clear)

Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: imu-comfault-pass
Excising rule: imu-comf-clear-pass-1
Excising rule: imu-comf-clear-pass-2
Excising rule: imu-failed-pass
Excising rule: imu-deselected-pass
Excising rule: imu-reselected-pass
Excising rule: three-good-imus
Excising rule: two-good-imus
Excising rule: one-good-imu
Excising rule: no-good-imu
Excising rule: imu-comfault-bfs
Excising rule: imu-comf-clear-bfs-not-engaged
Excising rule: imu-comf-clear-bfs-engaged-part1
Excising rule: imu-comf-clear-bfs-engaged-part2
Excising rule: imu-failed-bfs
Excising rule: imu-deselected-bfs-1-not-engaged
Excising rule: imu-deselected-bfs-2-not-engaged
Excising rule: imu-deselected-bfs-engaged
Excising rule: imu-reselect-bfs-engaged
Excising rule: imu-change-bfs
Excising rule: valid-velocity
Excising rule: invalid-velocity
Excising rule: valid-attitude
Excising rule: invalid-attitude
Excising rule: valid-to-use-acc-comparison
Excising rule: valid-acc
Excising rule: invalid-acc
Excising rule: velocity-comparison-1
Excising rule: velocity-comparison-2
Excising rule: attitude-comparison-1

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OF POOR QUALITY

```
Excising rule: attitude-comparison-2
Excising rule: acc-comparison-1
Excising rule: acc-comparison-2
Excising rule: worst-comparison
Excising rule: three-level-component-isolation
Excising rule: two-level-gnd-comparison
Excising rule: two-level-gnd-cant-vote
Excising rule: two-level-state-comparison
Excising rule: two-level-state-cant-vote
Excising rule: two-level-acc-comparison
Excising rule: two-level-acc-cant-vote
Excising rule: partial-imu-velocity
Excising rule: partial-imu-attitude
Excising rule: partial-imu-acc
Excising rule: partial-imu-cant-vote
Excising rule: two-level-vote-count
Excising rule: two-level-imu-isolation
Excising rule: two-level-component-isolation
Excising rule: two-level-cant-isolate
Excising rule: two-level-vote-cleanup
Excising rule: change-imu-quality
Excising rule: imu-status-light
Excising rule: bias-magnitude
Excising rule: resolver-magnitude
Excising rule: initial-misalignment
Excising rule: drift-magnitude
Excising rule: three-level-failure-prediction
Excising rule: three-level-no-failure-prediction
Excising rule: two-level-failure-prediction
Excising rule: reselect-imu-with-one-or-three-state-nav
Excising rule: help-imu-dilemma
Excising rule: cant-help-imu-dilemma
Excising rule: end-imu-dilemma
Excising rule: incorrect-imu-failure
Excising rule: deselect-comfaulted-imu
Excising rule: deselect-imu-in-bfs
Excising rule: no-bfs-imus
Excising rule: change-bfs-imu-1
Excising rule: change-bfs-imu-2
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lru-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff+j
```

```
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "ban/init")
Processing deffacts block: monitoring-init-phases
Processing deffacts block: init-phase-facts
Processing deffacts block: string-phases
Processing deffacts block: initial-strings
Compiling rule: engaged-system-is-bfs +j+j+j
Compiling rule: engaged-system-is-pass =j+j+j
Compiling rule: system-availability-bfs-only =j+j+j+j
Compiling rule: system-availability-pass-only =j+j+j+j
Compiling rule: system-availability-both =j+j+j
Compiling rule: wrong-atmosphere =j+j+j
Compiling rule: right-atmosphere =j+j+j
Compiling rule: wrong-major-mode =j+j+j
Compiling rule: commfault-string-pass +j+j+j
Compiling rule: commfault-string-bfs =j+j+j
Compiling rule: clear-string-pass +j+j+j
Compiling rule: clear-string-bfs +j+j+j
CLIPS> (reset)
==>f-0    (initial-fact)
==>f-1    (common-lru p-1-2 p-1-3 1)
==>f-2    (common-lru p-1-2 p-1-3 2)
==>f-3    (common-lru p-1-2 p-1-3 3)
==>f-4    (common-lru p-1-2 p-1-3 3)
==>f-5    (common-lru p-2-3 p-2-3 3)
==>f-6    (excluded-lru p-1-2 3)
==>f-7    (excluded-lru p-1-3 2)
==>f-8    (excluded-lru p-2-3 1)
==>f-9    (lrus-in-pair p-1-2 2)
==>f-10   (lrus-in-pair p-1-2 1)
==>f-11   (lrus-in-pair p-1-3 3)
==>f-12   (lrus-in-pair p-2-3 3)
==>f-13   (lrus-in-pair p-2-3 2)
==>f-14   (min-miscompare zero zero zero)
==>f-15   (min-miscompare zero under zero zero)
==>f-16   (min-miscompare zero over zero zero)
==>f-17   (min-miscompare zero under zero)
==>f-18   (min-miscompare zero under under)
==>f-19   (min-miscompare zero under under)
==>f-20   (min-miscompare over under under)
==>f-21   (min-miscompare zero over under under)
==>f-22   (min-miscompare zero 050 zero)
==>f-23   (min-miscompare zero under 050 under)
==>f-24   (min-miscompare 050 050 050)
==>f-25   (min-miscompare zero over 050)
==>f-26   (min-miscompare zero over zero)
==>f-27   (min-miscompare zero under over under)
==>f-28   (min-miscompare 050 over 050)
==>f-29   (min-miscompare over over over)
==>f-30   (max-miscompare zero zero zero)
```

```
f-33  (max-miscompare under zero under)
f-34  (max-miscompare o50 zero o50)
f-35  (max-miscompare over zero over)
f-39  (max-miscompare zero under under)
f-39  (max-miscompare under under under)
f-39  (max-miscompare o50 under o50)
f-40  (max-miscompare over under over)
f-41  (max-miscompare zero o50 o50)
f-42  (max-miscompare under o50 o50)
f-43  (max-miscompare o50 o50 o50)
f-44  (max-miscompare over o50 over)
f-45  (max-miscompare zero over over)
f-46  (max-miscompare under over over)
f-47  (max-miscompare o50 over over)
f-48  (max-miscompare over over over)
f-49  (fault-matrix under under under good)
f-50  (fault-matrix o50 under under velocity)
f-51  (fault-matrix over under under velocity)
f-52  (fault-matrix under o50 under attitude)
f-53  (fault-matrix under over under attitude)
f-54  (fault-matrix under under o50 attitude)
f-55  (fault-matrix under under over attitude)
f-56  (fault-matrix o50 o50 under resolver)
f-57  (fault-matrix over o50 under resolver)
f-58  (fault-matrix o50 over under resolver)
f-59  (fault-matrix over over under resolver)
f-60  (fault-matrix o50 under o50 bias)
f-61  (fault-matrix over under o50 bias)
f-62  (fault-matrix o50 under over bias)
f-63  (fault-matrix over under over bias)
f-64  (fault-matrix under o50 o50 drift)
f-65  (fault-matrix under over o50 drift)
f-66  (fault-matrix under o50 over drift)
f-67  (fault-matrix under over over drift)
f-68  (fault-matrix o50 o50 o50 suspect)
f-69  (fault-matrix over o50 o50 suspect)
f-70  (fault-matrix o50 over o50 suspect)
f-71  (fault-matrix over over o50 suspect)
f-72  (fault-matrix o50 o50 over suspect)
f-73  (fault-matrix over o50 over suspect)
f-74  (fault-matrix o50 over over suspect)
f-75  (fault-matrix over over over suspect)
f-76  (quality-table zero good)
f-77  (quality-table under good)
f-78  (quality-table o50 suspect)
f-79  (quality-table over bad)
f-80  (tacan-quality under under under good)
f-81  (tacan-quality under under over noise)
f-82  (tacan-quality under o50 under bias)
f-83  (tacan-quality under o50 over noise)
f-84  (tacan-quality under over under bias)
f-85  (tacan-quality under over over noise)
f-86  (tacan-quality over under under timing)
f-87  (tacan-quality over under over noise)
f-88  (tacan-quality over o50 under timing)
f-89  (tacan-quality over o50 over noise)
```

```
(tacan-quality over over under timing?)
(tacan-quality over over over bad?)
(usable-quality under under good?)
(usable-quality under 050 good?)
(usable-quality under over bad?)
(usable-quality 050 under good?)
(usable-quality 050 050 good)
(usable-quality 050 over bad)
(usable-quality over under bad)
(usable-quality over over bad)
(measurement-name tacr range)
(measurement-name tach bearing)
(measurement-name misr range?)
(measurement-name misa azimuth)
(measurement-name mise elevation)
(units range feet)
(units bearing degrees)
(units elevation degrees)
(units drag feet)
(units tacr feet)
(units baro feet)
(units misr feet)
(units tacb degrees)
(units misa degrees)
(units mise degrees)
(same-area 1)
(same-area 2)
(same-area 3)
(same-area 4)
(same-area 5)
(same-area 6)
(same-area 7)
(same-area 8)
(same-area 9)
(same-area 10)
(same-area 11)
(same-area 12)
(same-area 13)
(same-area 14)
(same-area 15)
(same-area 16)
(same-area 17)
(same-area 18)
(same-area 19)
(same-area 20)
(same-area 21)
(same-area 22)
(same-area 23)
(same-area 24)
(same-area 25)
(same-area 26)
(same-area 27)
(same-area 28)
(same-area 29)
(same-area 30)
```

```
==> f-145   (same-area 30 29)
==> f-146   (phase fact-assertion)
==      Activation  0 control-kickoff; f-146
==> f-147   (next-phase fact-assertion monitoring)
==      Activation  1 control-change-phase; f-147  f-146
==> f-148   (next-phase monitoring analysis)
==> f-149   (next-phase analysis output)
==> f-150   (next-phase output fact-assertion)
==> f-151   (first-phase init monitoring status)
==> f-152   (engaged-system none)
==> f-153   (system-available none)
==> f-154   (first-sub-phase string monitoring commfault)
==> f-155   (first-sub-phase string analysis clear)
==> f-156   (prev-string-cf pass 1 off)
==> f-157   (prev-string-cf pass 2 off)
==> f-158   (prev-string-cf pass 3 off)
==> f-159   (prev-string-cf pass 4 off)
==> f-160   (prev-string-cf bfs 1 off)
==> f-161   (prev-string-cf bfs 2 off)
==> f-162   (prev-string-cf bfs 3 off)
==> f-163   (prev-string-cf bfs 4 off)
CLIPS> (assert (single step))
==> f-164   (single step)
CLIPS> (run)
FIRE  1 control-kickoff; f-146
FIRE  2 control-change-phase; f-147  f-146
==> f-146  (phase fact-assertion)
==      (phase monitoring)
==      Activation  2 control-kickoff-subphase; f-165  f-154
==> f-165  (control-kickoff-subphase; f-165  f-151
FIRE  3 control-kickoff-subphase; f-165  f-165  f-151
==> Activation  4 control-change-phase; f-148  f-151
FIRE  3 control-kickoff-subphase; f-165  f-165
==> f-166  (sub-phase init status)
==> Activation  5 control-last-subphase; f-166
FIRE  4 control-kickoff-subphase; f-165  f-154
==      sub-phase string commfault)
==      Activation  6 control-last-subphase; f-167
==> f-167  (sub-phase string commfault)
FIRE  5 control-last-subphase; f-167
==> f-167  (sub-phase string commfault)
FIRE  6 control-last-subphase; f-166
==> f-166  (sub-phase init status)
FIRE  7 control-change-phase; f-148  f-151
==      (phase monitoring)
==      (phase analysis)
==      Activation  8 control-kickoff-subphase; f-145  f-155
FIRE  8 control-change-phase; f-148  f-155
==> f-169  (sub-phase string clear)
==> Activation  9 control-last-subphase; f-169
FIRE  9 control-last-subphase; f-169
==> f-169  (sub-phase string clear)
FIRE 10 control-change-phase; f-149  f-155
==> f-169  (sub-phase string clear)
FIRE 10 control-change-phase; f-149  f-155
==      (phase analysis)
==      (phase output)
==      Activation 10 control-change-phase; f-151  f-165
==      Activation 11 control-end-of-cycle; f-164  f-147
```

```
FIRE 11 control-end-of-cycle:  f-164   f-170
11 rules fired
Run time is 2.5000 seconds
CLIPS>(clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: engaged-system-is-bfs
Excising rule: engaged-system-is-pass
Excising rule: system-availability-bfs-only
Excising rule: system-availability-pass-only
Excising rule: system-availability-both
Excising rule: wrong-atmosphere
Excising rule: right-atmosphere
Excising rule: wrong-major-mode
Excising rule: commfault-string-pass
Excising rule: commfault-string-bfs
Excising rule: clear-string-pass
Excising rule: clear-string-bfs
CLIPS>(load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS>(load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS>(load "Dan/msbls.r")
Processing deffacts block: monitoring-msbls-phases
Processing deffacts block: analysis-msbls-phases
Processing deffacts block: initial-msbls-facts
Compiling rule: msbls-commfault +j+j+j+j
Compiling rule: msbls-commfault-clear +j+j+j+j+j+j+j+j+j
Compiling rule: msbls-failed =j+j+j
Compiling rule: msbls-power-off =j+j+j
Compiling rule: msbls-power-on =j+j+j+j+j+j+j+j
Compiling rule: three-msbls-avail =j+j+j+j+j
Compiling rule: two-msbls-avail =j+j+j+j+j
Compiling rule: one-msbls-avail =j+j+j+j+j
```

```
Compiling rule: no-msbls-avail =j+j+j+j
Compiling rule: check-channel =j+j+j+j+j
Compiling rule: three-msbls-locked =j+j+j+j+j+j
Compiling rule: two-msbls-locked =j+j+j+j+j
=j+j+j+
Compiling rule: one-msbls-locked =j+j+j+j+j
Compiling rule: no-msbls-locked =j+j+j+j+j+j
Compiling rule: initial-msbls-check =j+j+j+j+j
Compiling rule: msbls-error-change =j+j+j+j+j+j
Compiling rule: msbls-lru-quality =j+j+j+j
=j+j+j+
Compiling rule: msbls-lru-quality-2 =j+j+j+j+j+j+j+j
Compiling rule: msbls-filter-flag-changed =j+j+j+j
Compiling rule: msbls-data-good-flag-changed =j+j+j+j
Compiling rule: msbls-dilemma =j+j
Compiling rule: three-level-msbls-deselect-1 +j+j+j+j+j+j
Compiling rule: three-level-msbls-force-tacan-1 =j+j=j+j=j+j
Compiling rule: three-level-msbls (rm fail) =j+j+j+j+j
Compiling rule: three-level-msbls-deselect-2 =j+j=j+j+j
Compiling rule: three-level-msbls-force-tacan-2 =j+j=j+j=j+j
Compiling rule: two-level-msbls-deselect =j+j+j+j+j+j
Compiling rule: two-level-msbls-force-tacan =j+j+j+j
Compiling rule: one-level-msbls-force-tacan =j+j+j+j
Compiling rule: do-not-force-tacan =j+j+j+j+j
Compiling rule: error-before-msbls +j+j+j+j+j
Compiling rule: error-after-msbls =j+j+j+j+j

CLIPS> (reset)
==> f-0   (initial-fact)
==> f-1   (common-lru p-1-2 p-1-3 1)
==> f-2   (common-lru p-2-3 p-1-2 2)
==> f-3   (common-lru p-1-2 p-1-3 2)
==> f-4   (common-lru p-2-3 p-1-2 3)
==> f-5   (common-lru p-1-3 p-2-3 2)
==> f-6   (common-lru p-2-3 p-1-3 3)
==> f-7   (excluded-lru p-1-3)
==> f-8   (excluded-lru p-1-2)
==> f-9   (excluded-lru p-2-3)
==> f-10  (lrus-in-pair p-1-2 2)
==> f-11  (lrus-in-pair p-1-3 2)
==> f-12  (lrus-in-pair p-1-3 3)
==> f-13  (lrus-in-pair p-2-3 3)
==> f-14  (lrus-in-pair p-2-3 2)
==> f-15  (min-miscompare zero zero zero)
==> f-16  (min-miscompare zero under zero)
==> f-17  (min-miscompare 050 zero zero)
==> f-18  (min-miscompare over zero zero)
==> f-19  (min-miscompare over zero under)
==> f-20  (min-miscompare under zero under)
==> f-21  (min-miscompare under under under)
==> f-22  (min-miscompare 050 under under)
==> f-23  (min-miscompare over under under)
==> f-24  (min-miscompare zero over under under)
==> f-25  (min-miscompare zero 050 zero)
==> f-26  (min-miscompare under 050 under)
==> f-27  (min-miscompare over 050 050)
==> f-28  (min-miscompare zero over zero)
```

```
>> f-29 :: == (min-miscompare under over under)
>> f-30 :: == (min-miscompare o50 over o50)
>> f-31 :: == (min-miscompare over over over)
>> f-32 :: == (max-miscompare zero zero zero)
>> f-33 :: == (max-miscompare under zero under)
>> f-34 :: == (max-miscompare o50 zero o50)
>> f-35 :: == (max-miscompare over zero over)
>> f-36 :: == (max-miscompare zero under under)
>> f-37 :: == (max-miscompare under under under)
>> f-38 :: == (max-miscompare o50 under o50)
>> f-39 :: == (max-miscompare over under over)
>> f-40 :: == (max-miscompare zero o50 o50)
>> f-41 :: == (max-miscompare under o50 o50)
>> f-42 :: == (max-miscompare o50 o50 o50)
>> f-43 :: == (max-miscompare over o50 over)
>> f-44 :: == (max-miscompare zero over over)
>> f-45 :: == (max-miscompare under over over)
>> f-46 :: == (max-miscompare o50 over over)
>> f-47 :: == (max-miscompare over over over)
>> f-48 :: == (fault-matrix over over over good)
>> f-49 :: == (fault-matrix o50 under under velocity)
>> f-50 :: == (fault-matrix over under under attitude)
>> f-51 :: == (fault-matrix under o50 under attitude)
>> f-52 :: == (fault-matrix over under under attitude)
>> f-53 :: == (fault-matrix under o50 under attitude)
>> f-54 :: == (fault-matrix o50 o50 under resolver)
>> f-55 :: == (fault-matrix over o50 under resolver)
>> f-56 :: == (fault-matrix o50 over under resolver)
>> f-57 :: == (fault-matrix over over under resolver)
>> f-58 :: == (fault-matrix over over under resolver)
>> f-59 :: == (fault-matrix o50 under o50 bias)
>> f-60 :: == (fault-matrix over under o50 bias)
>> f-61 :: == (fault-matrix o50 under over bias)
>> f-62 :: == (fault-matrix over over over bias)
>> f-63 :: == (fault-matrix o50 o50 o50 drift)
>> f-64 :: == (fault-matrix over o50 o50 drift)
>> f-65 :: == (fault-matrix o50 under o50 drift)
>> f-66 :: == (fault-matrix over over over drift)
>> f-67 :: == (fault-matrix o50 o50 o50 suspect)
>> f-68 :: == (fault-matrix over o50 o50 suspect)
>> f-69 :: == (fault-matrix o50 over o50 suspect)
>> f-70 :: == (fault-matrix over over o50 suspect)
>> f-71 :: == (fault-matrix o50 o50 over suspect)
>> f-72 :: == (fault-matrix over o50 over suspect)
>> f-73 :: == (fault-matrix o50 over over suspect)
>> f-74 :: == (fault-matrix over over over suspect)
>> f-75 :: == (quality-table zero good)
>> f-76 :: == (quality-table under good)
>> f-77 :: == (quality-table o50 suspect)
>> f-78 :: == (quality-table over bad)
>> f-79 :: == (tacan-quality under under good)
>> f-80 :: == (tacan-quality under over good)
>> f-81 :: == (tacan-quality under over noise)
>> f-82 :: == (tacan-quality under o50 bias)
>> f-83 :: == (tacan-quality over under bias)
>> f-84 :: == (tacan-quality under over noise)
```

```
f-085  (tacan-quality over under under timing)
f-086  (tacan-quality over under over noise)
f-087  (tacan-quality over 050 under timing)
f-088  (tacan-quality over 050 over noise)
f-089  (tacan-quality over over under timing)
f-090  (tacan-quality over over over noise)
f-091  (msbls-quality under under good)
f-092  (msbls-quality under 050 good)
f-093  (msbls-quality under over bad)
f-094  (msbls-quality 050 under good)
f-095  (msbls-quality 050 050 good)
f-096  (msbls-quality 050 over bad)
f-097  (msbls-quality over under bad)
f-098  (msbls-quality over 050 bad)
f-099  (msbls-quality over over bad)
f-100  (measurement-name tacr range)
f-101  (measurement-name tacb bearing)
f-102  (measurement-name misr range)
f-103  (measurement-name misa azimuth)
f-104  (measurement-name mise elevation)
f-105  (units range feet)
f-106  (units bearing degrees)
f-107  (units azimuth degrees)
f-108  (units elevation degrees)
f-109  (units drag feet)
f-110  (units baro feet)
f-111  (units tacr feet)
f-112  (units misr feet)
f-113  (units tacb degrees)
f-114  (units misa degrees)
f-115  (units mise degrees)
f-116  (same-area 1 2)
f-117  (same-area 2 1)
f-118  (same-area 3 4)
f-119  (same-area 4 3)
f-120  (same-area 5 6)
f-121  (same-area 6 5)
f-122  (same-area 7 8)
f-123  (same-area 8 7)
f-124  (same-area 9 10)
f-125  (same-area 10 9)
f-126  (same-area 11 12)
f-127  (same-area 12 11)
f-128  (same-area 13 14)
f-129  (same-area 14 13)
f-130  (same-area 15 16)
f-131  (same-area 16 15)
f-132  (same-area 17 18)
f-133  (same-area 18 17)
f-134  (same-area 19 20)
f-135  (same-area 20 19)
f-136  (same-area 21 22)
f-137  (same-area 22 21)
f-138  (same-area 23 24)
f-139  (same-area 24 23)
f-140  (same-area 25 26)
```

```
== >> = f-141  (same-area 26 25)
== >> = f-142  (same-area 27 28)
== >> = f-143  (same-area 28 27)
== >> = f-144  (same-area 29 30)
== >> = f-145  (same-area 30 29)
== >> = f-146  (phase fact-assertion)
Activation  0 control-kickoff;  f-146
== >> = f-147  (next-phase fact-assertion monitoring)  f-146
Activation  1 control-change-phases:  f-147  f-146
== >> = f-148  (next-phase monitoring analysis)
== >> = f-149  (next-phase analysis output)
== >> = f-150  (next-phase output fact-assertion)
== >> = f-151  (first-sub-phase msbis monitoring availability)
== >> = f-152  (next-sub-phase msbis availability lockon)
== >> = f-153  (next-sub-phase msbis lockon quality)
== >> = f-154  (next-sub-phase msbis quality watch-flags)
== >> = f-155  (first-sub-phase msbis analysis recommendation)
== >> = f-156  (next-sub-phase msbis recommendation watch-state)
== >> = f-157  (msbis-status 1 avail)
== >> = f-158  (msbis-status 2 avail)
== >> = f-159  (msbis-status 3 avail)
== >> = f-160  (msbis-num-avail 3)
== >> = f-161  (msbis-num-locked range 0)
== >> = f-162  (msbis-num-locked azimuth 0)
== >> = f-163  (msbis-num-locked elevation 0)
== >> = f-164  (last-msbis-report 1 range bias unknown)
== >> = f-165  (last-msbis-report 1 range noise unknown)
== >> = f-166  (last-msbis-report 1 azimuth bias unknown)
== >> = f-167  (last-msbis-report 1 azimuth noise unknown)
== >> = f-168  (last-msbis-report 1 elevation bias unknown)
== >> = f-169  (last-msbis-report 1 elevation noise unknown)
== >> = f-170  (last-msbis-report 2 range bias unknown)
== >> = f-171  (last-msbis-report 2 range noise unknown)
== >> = f-172  (last-msbis-report 2 azimuth bias unknown)
== >> = f-173  (last-msbis-report 2 azimuth noise unknown)
== >> = f-174  (last-msbis-report 2 elevation bias unknown)
== >> = f-175  (last-msbis-report 2 elevation noise unknown)
== >> = f-176  (last-msbis-report 3 range bias unknown)
== >> = f-177  (last-msbis-report 3 range noise unknown)
== >> = f-178  (last-msbis-report 3 azimuth bias unknown)
== >> = f-179  (last-msbis-report 3 azimuth noise unknown)
== >> = f-180  (last-msbis-report 3 elevation bias unknown)
== >> = f-181  (last-msbis-report 3 elevation noise unknown)
== >> = f-182  (msbis-lru-quality 1 range none)
== >> = f-183  (msbis-lru-quality 1 azimuth none)
== >> = f-184  (msbis-lru-quality 1 elevation none)
== >> = f-185  (msbis-lru-quality 2 range none)
== >> = f-186  (msbis-lru-quality 2 azimuth none)
== >> = f-187  (msbis-lru-quality 2 elevation none)
== >> = f-188  (msbis-lru-quality 3 range none)
== >> = f-189  (msbis-lru-quality 3 azimuth none)
== >> = f-190  (msbis-lru-quality 3 elevation none)
== >> = f-191  (error-before-msbis under)
== >> = f-192  (prev-filter-flag pass misr off)
== >> = f-193  (prev-filter-flag pass misa off)
== >> = f-194  (prev-filter-flag pass mise off)
```

```
==> f-195    (prev-data-good pass misr off)
==> f-196    (prev-data-good pass mise off)
==> f-197    (prev-data-good pass mise off)
CLIPS> (assert (single step))
CLIPS> (run)
FIRE   1 control-kickoff: f-146
FIRE   2 control-change-phases: f-147 f-146
==> f-146   (phase fact-assertion)
==> f-199   (phase monitoring)
==> Activation  2 control-kickoff-subphase: f-199 f-151
==> Activation  3 control-change-phase: f-148 f-199
FIRE   3 control-kickoff-subphase: f-199 f-151
==> f-200   (sub-phase msbis availability?)
==> Activation  4 control-last-subphase: f-200
==> Activation  5 control-next-subphase: f-200 f-152
FIRE   4 control-next-subphase: f-200 f-152
==> f-200   (sub-phase msbis availability?)
==> Activation  4 control-last-subphase: f-200
==> f-201   (sub-phase msbis lockon)
==> Activation  6 control-last-subphase: f-201
FIRE   5 control-next-subphase: f-201 f-153
==> f-201   (sub-phase msbis lockon)
==> Activation  6 control-last-subphase: f-201
==> f-202   (sub-phase msbis quality?)
==> Activation  8 control-last-subphase: f-202
==> Activation  9 control-next-subphase: f-202 f-154
FIRE   6 control-next-subphase: f-202 f-154
==> f-202   (sub-phase msbis quality?)
==> Activation  8 control-last-subphase: f-202
==> f-203   (sub-phase msbis watch-flags)
==> Activation 10 control-last-subphase: f-203
FIRE   7 control-last-subphase: f-203
FIRE   8 control-change-phases: f-148 f-199
==> f-199   (phase monitoring)
==> f-204   (phase analysis?)
==> Activation 11 control-kickoff-subphase: f-204 f-155
==> Activation 12 control-change-phase: f-149 f-204
FIRE   9 control-kickoff-subphase: f-204 f-155
==> f-205   (sub-phase msbis recommendation)
==> Activation 13 control-last-subphase: f-205
==> Activation 14 control-next-subphase: f-205 f-156
FIRE  10 control-next-subphase: f-205 f-156
==> f-205   (sub-phase msbis recommendation)
==> Activation 13 control-last-subphase: f-205
==> f-206   (sub-phase msbis watch-state)
==> Activation 15 control-last-subphase: f-206
FIRE  11 control-last-subphase: f-206
==> f-206   (sub-phase msbis watch-state)
==> Activation 15 control-change-phases: f-149 f-204
FIRE  12 control-change-phases: f-149 f-204
==> f-204   (phase analysis)
==> f-207   (phase output)
==> Activation 16 control-change-phases: f-150 f-207
==> Activation 17 control-end-of-cycle: f-198 f-207
```

```
FIRE   13 control-end-of-cycle: f-198   f-207
13 rules fired
Run time is 11.2500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phase
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-test-subphase
Excising rule: msbis-commfault
Excising rule: msbis-commfault-clear
Excising rule: msbis-failed
Excising rule: msbis-power-off
Excising rule: msbis-power-on
Excising rule: three-msbis-avail
Excising rule: two-msbis-avail
Excising rule: one-msbis-avail
Excising rule: no-msbis-avail
Excising rule: check-channel
Excising rule: three-msbis-locked
Excising rule: two-msbis-locked
Excising rule: one-msbis-locked
Excising rule: no-msbis-locked
Excising rule: initial-msbis-check
Excising rule: msbis-error-change
Excising rule: msbis-lru-quality-1
Excising rule: msbis-lru-quality-2
Excising rule: msbis-filter-flag-changed
Excising rule: msbis-data-good-flag-changed
Excising rule: msbis-dilemma
Excising rule: three-level-msbis-deselect-1
Excising rule: three-level-msbis-force-tacan-1
Excising rule: three-level-msbis-rm-fail
Excising rule: three-level-msbis-deselect-2
Excising rule: three-level-msbis-force-tacan-2
Excising rule: two-level-msbis-deselect
Excising rule: two-level-msbis-force-tacan
Excising rule: one-level-msbis-force-tacan
Excising rule: do-not-force-tacan
Excising rule: error-before-msbis
Excising rule: error-after-msbis
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbis-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
```

```
...processing deffacts block: control-initial-phase
Processing deffacts block: control-initial-phase
Compiling rule: control-kickoff +j
Compiling rule: control-phase
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
CLIPS> (load "Dan/operator.r")
Compiling rule: operator-stop +j
Compiling rule: operator-subsystem =j+j
Compiling rule: operator-delta-state =j+j+j
Compiling rule: operator-changed-delta-state -j=j+j
Compiling rule: operator-b's-no-go =j+j+j
Compiling rule: operator-runway-selection =j+j+j
Compiling rule: operator-toggle-tacan =j+j+j+j+j+j
Compiling rule: operator-cant-toggle =j=j+j+j+j+j
CLIPS> (reset)
f-0    <Initial-fact>
f-1    (common-lru p-1-2 p-1-2 1)
f-2    (common-lru p-1-3 p-1-2 1)
f-3    (common-lru p-1-2 p-1-2 2)
f-4    (common-lru p-2-1 p-2-2 2)
f-5    (common-lru p-1-3 p-2-3 2)
f-6    (common-lru p-2-3 p-2-3 3)
f-7    (common-lru p-1-3 p-1-3 3)
f-8    (excluded-lru p-1-2 2)
f-9    (excluded-lru p-1-2 3)
f-10   (lrus-in-pair p-1-2 3)
f-11   (lrus-in-pair p-1-2 2)
f-12   (lrus-in-pair p-1-3 2)
f-13   (lrus-in-pair p-1-3 3)
f-14   (lrus-in-pair p-1-3 1)
f-15   (lrus-in-pair p-2-3 3)
f-16   (lrus-in-pair p-2-3 2)
f-17   (min-miscompare zero zero zero)
f-18   (min-miscompare zero zero zero)
f-19   (min-miscompare o50 zero zero)
f-20   (min-miscompare zero over zero)
f-21   (min-miscompare zero under zero)
f-22   (min-miscompare zero under under)
f-23   (min-miscompare o50 under under)
f-24   (min-miscompare zero over under)
f-25   (min-miscompare zero o50 under)
f-26   (min-miscompare o50 o50 under)
f-27   (min-miscompare o50 o50 o50)
       (min-miscompare zero over o50)
       (min-miscompare under o50 under)
       (min-miscompare o50 over o50)
       (min-miscompare over over over)
       (min-miscompare zero zero over)
       (...compare under zero over)
       (...pare o50 zero o50)
       (...re o50 zero o50)
       (...ver zero over)
       (...under under)
       (...er under)
```

```
= = >>> f-38  (max-miscompare o50 under o50)
= = >>> f-39  (max-miscompare over under over)
= = >>> f-40  (max-miscompare zero o50 o50)
= = >>> f-41  (max-miscompare under o50 o50)
= = >>> f-42  (max-miscompare o50 o50 o50)
= = >>> f-43  (max-miscompare over o50 over)
= = >>> f-44  (max-miscompare zero over over)
= = >>> f-45  (max-miscompare under over over)
= = >>> f-46  (max-miscompare o50 over over)
= = >>> f-47  (max-miscompare over over over)
= = >>> f-48  (fault-matrix under under good)
= = >>> f-49  (fault-matrix o50 under under velocity)
= = >>> f-50  (fault-matrix over under under velocity)
= = >>> f-51  (fault-matrix o50 under under attitude)
= = >>> f-52  (fault-matrix over under under attitude)
= = >>> f-53  (fault-matrix under under o50 attitude)
= = >>> f-54  (fault-matrix under under over attitude)
= = >>> f-55  (fault-matrix o50 o50 under resolver)
= = >>> f-56  (fault-matrix over o50 under resolver)
= = >>> f-57  (fault-matrix o50 over under resolver)
= = >>> f-58  (fault-matrix over over under resolver)
= = >>> f-59  (fault-matrix o50 under o50 bias)
= = >>> f-60  (fault-matrix over under o50 bias)
= = >>> f-61  (fault-matrix o50 under over bias)
= = >>> f-62  (fault-matrix over under over bias)
= = >>> f-63  (fault-matrix under o50 o50 drift)
= = >>> f-64  (fault-matrix under over o50 drift)
= = >>> f-65  (fault-matrix under o50 over drift)
= = >>> f-66  (fault-matrix under over over drift)
= = >>> f-67  (fault-matrix o50 o50 o50 suspect)
= = >>> f-68  (fault-matrix over o50 o50 suspect)
= = >>> f-69  (fault-matrix o50 over o50 suspect)
= = >>> f-70  (fault-matrix over over o50 suspect)
= = >>> f-71  (fault-matrix o50 o50 over suspect)
= = >>> f-72  (fault-matrix over o50 over suspect)
= = >>> f-73  (fault-matrix o50 over over suspect)
= = >>> f-74  (fault-matrix over over over suspect)
= = >>> f-75  (quality-table zero zero good)
= = >>> f-76  (quality-table under good)
= = >>> f-77  (quality-table o50 suspect)
= = >>> f-78  (quality-table over bad)
= = >>> f-79  (tacan-quality under under under good)
= = >>> f-80  (tacan-quality under under over noise)
= = >>> f-81  (tacan-quality o50 under bias)
= = >>> f-82  (tacan-quality o50 over noise)
= = >>> f-83  (tacan-quality under over under bias)
= = >>> f-84  (tacan-quality under over under noise)
= = >>> f-85  (tacan-quality over under under timing)
= = >>> f-86  (tacan-quality over under under noise)
= = >>> f-87  (tacan-quality over over under timing)
= = >>> f-88  (tacan-quality o50 under timing)
= = >>> f-89  (tacan-quality o50 over under noise)
= = >>> f-90  (tacan-quality over over under timing)
= = >>> f-91  (tacan-quality over over under noise)
= = >>> f-92  (msbls-quality under under good)
= = >>> f-93  (msbls-quality under over bad)
```

```
== => f-94   (msbls-quality o50 under good)
== => f-95   (msbls-quality o50 o50 good)
== => f-96   (msbls-quality o50 over bad)
== => f-97   (msbls-quality over under bad)
== => f-98   (msbls-quality over o50 bad)
== => f-99   (msbls-quality over over bad)
== => f-100  (measurement-name tacr range)
== => f-101  (measurement-name tacb bearing)
== => f-102  (measurement-name mlsr range)
== => f-103  (measurement-name mlse azimuth)
== => f-104  (measurement-name mlse elevation)
== => f-105  (units range feet)
== => f-106  (units bearing degrees)
== => f-107  (units azimuth degrees)
== => f-108  (units elevation degrees)
== => f-109  (units drag feet)
== => f-110  (units tacr feet)
== => f-111  (units bare feet)
== => f-112  (units mlsr feet)
== => f-113  (units tacb degrees)
== => f-114  (units mlsa degrees)
== => f-115  (units mlse degrees)
== => f-116  (same-area 1 2)
== => f-117  (same-area 2 1)
== => f-118  (same-area 3 4)
== => f-119  (same-area 4 3)
== => f-120  (same-area 5 6)
== => f-121  (same-area 6 5)
== => f-122  (same-area 7 8)
== => f-123  (same-area 8 7)
== => f-124  (same-area 9 10)
== => f-125  (same-area 10 9)
== => f-126  (same-area 11 12)
== => f-127  (same-area 12 11)
== => f-128  (same-area 13 14)
== => f-129  (same-area 14 13)
== => f-130  (same-area 15 16)
== => f-131  (same-area 16 15)
== => f-132  (same-area 17 18)
== => f-133  (same-area 18 17)
== => f-134  (same-area 19 20)
== => f-135  (same-area 20 19)
== => f-136  (same-area 21 22)
== => f-137  (same-area 22 21)
== => f-138  (same-area 23 24)
== => f-139  (same-area 24 23)
== => f-140  (same-area 25 26)
== => f-141  (same-area 26 25)
== => f-142  (same-area 27 28)
== => f-143  (same-area 28 27)
== => f-144  (same-area 29 30)
== => f-145  (same-area 30 29)
== => f-146  (phase fact-assertion)
== == Activation 0 control-kickoff: f-146
== => f-147  (next-phase fact-assertion monitoring) f-147 f-146
== == Activation 1 control-change-phases: f-147 f-146
```

```
==> f-148   (next-phase monitoring analysis)
==> f-149   (next-phase analysis output)
==> f-150   (next-phase output fact-assertion)
CLIPS> (assert (single step))
==> f-151   (single step)
CLIPS> (run)
FIRE  1 control-kickoff: f-146
FIRE  2 control-change-phases: f-147 f-146
<== f-146  (phase fact-assertion)
==> f-152  (phase monitoring)
==> Activation 2 control-change-phases: f-148 f-152  f-153
FIRE  3 control-change-phases: f-148 f-152  f-153
<== f-152  (phase monitoring)
==> f-153  (phase analysis)
==> Activation 3 control-change-phases: f-149 f-153  f-153
FIRE  4 control-change-phases: f-149 f-153
<== f-153  (phase analysis)
==> f-154  (phase output)
==> Activation 4 control-change-phases: f-150 f-154
==> Activation 5 control-end-of-cycle: f-151 f-154
FIRE  5 control-end-of-cycle: f-151 f-154
5 rules fired
Run time is 3.5000 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: operator-stop
Excising rule: operator-subsystem
Excising rule: operator-delta-state
Excising rule: operator-changed-delta-state
Excising rule: operator-bfs-no-go
Excising rule: operator-runway-selection
Excising rule: operator-toggle-tacan
Excising rule: operator-cant-toggle
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-path
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
```

```
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS>(load "gen/output.r")
Compiling rule: output-event +j+j
Compiling rule: output-recommendation +j+j+j+j
Compiling rule: output-hold-recommendation +j+j+j+j
Compiling rule: output-end-recommendation =j+j+j+j
Processing deffacts block: output-light-locations
Processing deffacts block: output-display-values
CLIPS>(reset)
==><f-0>    (initial-fact)
==><f-1>    (common-lru p=1-2 p=1-3 )
==><f-2>    (common-lru p=1-3 p=1-2 )
==><f-3>    (common-lru p=2-3 p=1-2 )
==><f-4>    (common-lru p=1-2 p=2-3 )
==><f-5>    (common-lru p=1-3 p=2-3 )
==><f-6>    (common-lru p=2-3 p=1-3 )
==><f-7>    (excluded-lru p=1-2-3 )
==><f-8>    (excluded-lru p=2-3 )
==><f-9>    (lcus-in-pair p=1-2 )
==><f-10>   (lcus-in-pair p=1-2 )
==><f-11>   (lcus-in-pair p=1-3 )
==><f-12>   (lcus-in-pair p=2-3 )
==><f-13>   (lcus-in-pair p=2-3 )
==><f-14>   (min-miscompare zero zero zero)
==><f-15>   (min-miscompare under zero zero)
==><f-17>   (min-miscompare o50 zero zero)
==><f-18>   (min-miscompare over zero zero)
==><f-19>   (min-miscompare zero under zero)
==><f-20>   (min-miscompare under under under)
==><f-21>   (min-miscompare o50 under under)
==><f-23>   (min-miscompare over under under)
==><f-24>   (min-miscompare zero o50 zero)
==><f-25>   (min-miscompare under o50 under)
==><f-26>   (min-miscompare o50 o50 under)
==><f-27>   (min-miscompare over o50 o50)
==><f-28>   (min-miscompare zero over zero)
==><f-30>   (min-miscompare under over under)
==><f-31>   (min-miscompare o50 over o50)
==><f-33>   (max-miscompare zero zero zero)
==><f-34>   (max-miscompare under zero under)
==><f-35>   (max-miscompare o50 zero o50)
==><f-36>   (max-miscompare over zero over)
==><f-37>   (max-miscompare zero under under)
==><f-39>   (max-miscompare under under under)
==><f-40>   (max-miscompare o50 under o50)
==><f-41>   (max-miscompare over under over)
==><f-42>   (max-miscompare zero o50 o50)
```

```
f-43   ( max-miscompare over o50 over )
f-44   ( max-miscompare zero over over )
f-45   ( max-miscompare under over over )
f-46   ( max-miscompare o50 over over )
f-48   ( max-miscompare over over over )
f-49   ( fault-matrix under under under good )
f-50   ( fault-matrix o50 under under velocity )
f-51   ( fault-matrix over under under velocity )
f-52   ( fault-matrix under o50 under attitude )
f-53   ( fault-matrix over under under attitude )
f-54   ( fault-matrix under under o50 attitude )
f-55   ( fault-matrix under over under attitude )
f-56   ( fault-matrix o50 o50 under resolver )
f-57   ( fault-matrix over o50 under resolver )
f-58   ( fault-matrix o50 over under resolver )
f-59   ( fault-matrix over over under resolver )
f-60   ( fault-matrix o50 under o50 bias )
f-61   ( fault-matrix over under o50 bias )
f-62   ( fault-matrix under over over bias )
f-63   ( fault-matrix under o50 o50 drift )
f-64   ( fault-matrix under over o50 drift )
f-65   ( fault-matrix under o50 over drift )
f-66   ( fault-matrix under over over drift )
f-67   ( fault-matrix o50 o50 o50 suspect )
f-68   ( fault-matrix over o50 o50 suspect )
f-69   ( fault-matrix o50 over o50 suspect )
f-70   ( fault-matrix over over o50 suspect )
f-71   ( fault-matrix o50 o50 over suspect )
f-72   ( fault-matrix over o50 over suspect )
f-73   ( fault-matrix o50 over over suspect )
f-74   ( fault-matrix over over over suspect )
f-75   ( quality-table zero under good )
f-76   ( quality-table o50 under good )
f-78   ( quality-table over under bad )
f-79   ( tacan-quality under under under good )
f-80   ( tacan-quality under under over noise )
f-81   ( tacan-quality under o50 under bias )
f-82   ( tacan-quality under o50 over noise )
f-83   ( tacan-quality under over under bias )
f-84   ( tacan-quality under over over noise )
f-85   ( tacan-quality over under under timing )
f-86   ( tacan-quality over under over noise )
f-87   ( tacan-quality over o50 under timing )
f-88   ( tacan-quality over o50 over noise )
f-89   ( tacan-quality over over under timing )
f-90   ( tacan-quality over over over noise )
f-91   ( msbls-quality under under under good )
f-92   ( msbls-quality under under o50 good )
f-93   ( msbls-quality under o50 under good )
f-94   ( msbls-quality o50 under over bad )
f-95   ( msbls-quality o50 o50 good )
f-96   ( msbls-quality o50 over bad )
f-97   ( msbls-quality over under o50 bad )
f-98   ( msbls-quality over o50 bad )
```

```
== >  f-94    (msbls-quality over over bad)
== >  f-100   (measurement-name tacr range)
== >  f-101   (measurement-name tacb bearing)
== >  f-102   (measurement-name mlsr range)
== >  f-103   (measurement-name mlsa azimuth)
== >  f-104   (measurement-name mlse elevation)
== >  f-105   (units range feet)
== >  f-106   (units bearing degrees)
== >  f-107   (units azimuth degrees)
== >  f-108   (units elevation degrees)
== >  f-109   (units drag feet)
== >  f-110   (units tacr feet)
== >  f-111   (units baro feet)
== >  f-112   (units mlsr feet)
== >  f-113   (units tacb degrees)
== >  f-114   (units mlsa degrees)
== >  f-115   (units mlse degrees)
== >  f-117   (same-area 1 2)
== >  f-118   (same-area 2 1)
== >  f-119   (same-area 3 4)
== >  f-120   (same-area 4 3)
== >  f-121   (same-area 5 6)
== >  f-122   (same-area 6 5)
== >  f-123   (same-area 7 8)
== >  f-124   (same-area 8 7)
== >  f-125   (same-area 9 10)
== >  f-126   (same-area 10 9)
== >  f-127   (same-area 11 12)
== >  f-128   (same-area 12 11)
== >  f-129   (same-area 13 14)
== >  f-130   (same-area 14 13)
== >  f-131   (same-area 15 16)
== >  f-132   (same-area 16 15)
== >  f-133   (same-area 17 18)
== >  f-134   (same-area 18 17)
== >  f-135   (same-area 19 20)
== >  f-136   (same-area 20 19)
== >  f-137   (same-area 21 22)
== >  f-138   (same-area 22 21)
== >  f-139   (same-area 23 24)
== >  f-140   (same-area 24 23)
== >  f-141   (same-area 25 26)
== >  f-142   (same-area 26 25)
== >  f-143   (same-area 27 28)
== >  f-144   (same-area 28 27)
== >  f-145   (same-area 29 30)
== >  f-146   (same-area 30 29)
== >  f-145   (phase fact-assertion)
== >  Activation 0 control-kickoff:  f-146
== >  Activation 1 next-phase fact-assertion monitoring)  f-147  f-146
== >  f-148   (next-phase control-change-phase)  f-147  f-146
== >  f-149   (next-phase monitoring analysis)  f-147
== >  f-150   (next-phase analysis output)
== >  f-151   (next-phase output fact-assertion)
== >  f-151   (light-location runway pass 1 10)
== >  f-152   (light-location runway Bfs 1 15)
```

```
f-153  ==  (light-location runway ground 1 20)
f-154  ==  (light-location tacan pass 2 10)
f-155  ==  (light-location tacan bfs 2 15)
f-156  ==  (light-location state pass 3 10)
f-157  ==  (light-location state bfs 3 15)
f-158  ==  (light-location state ground 3 20)
f-159  ==  (light-location three-state 1 6 10)
f-160  ==  (light-location three-state 2 6 15)
f-161  ==  (light-location three-state 3 6 20)
f-162  ==  (light-location pass-imu 1 7 10)
f-163  ==  (light-location pass-imu 2 7 15)
f-164  ==  (light-location pass-imu 3 7 20)
f-165  ==  (light-location bfs-imu 1 8 10)
f-166  ==  (light-location bfs-imu 2 8 15)
f-167  ==  (light-location bfs-imu 3 8 20)
f-168  ==  (light-location drag 0 9 10)
f-169  ==  (light-location tacr 1 10 10)
f-170  ==  (light-location tacr 2 10 15)
f-171  ==  (light-location tacr 3 10 20)
f-172  ==  (light-location tacb 1 11 10)
f-173  ==  (light-location tacb 2 11 15)
f-174  ==  (light-location tacb 3 11 20)
f-175  ==  (light-location tacb cone 11 0)
f-176  ==  (light-location baro 0 12 10)
f-177  ==  (light-location misr 1 13 10)
f-178  ==  (light-location misr 2 13 20)
f-179  ==  (light-location misr 3 13 10)
f-180  ==  (light-location misa 1 14 10)
f-181  ==  (light-location misa 2 14 15)
f-182  ==  (light-location misa 3 14 20)
f-183  ==  (light-location mlse 1 15 10)
f-184  ==  (light-location mlse 2 15 15)
f-185  ==  (light-location mlse 3 15 20)
f-186  ==  (light-location tim 0 16 10)
f-187  ==  (display-value unknown "    " normal)
f-188  ==  (display-value blank "    " normal)
f-189  ==  (display-value none "    " normal)
f-190  ==  (display-value go "Go" normal)
f-191  ==  (display-value good "GOOD" normal)
f-192  ==  (display-value high "HIGH" normal)
f-193  ==  (display-value low "LOW" normal)
f-194  ==  (display-value no-go "NOGO" blink)
f-195  ==  (display-value bias "BIAS" blink)
f-196  ==  (display-value resolver "RSLV" blink)
f-197  ==  (display-value drift "DRFT" blink)
f-198  ==  (display-value velocity "VEL" blink)
f-199  ==  (display-value attitude "ATTD" blink)
f-200  ==  (display-value suspect "SPCT" blink)
f-201  ==  (display-value timing "TIME" blink)
f-202  ==  (display-value noise "NOIS" blink)
f-203  ==  (display-value atmos "ATMS" blink)
f-204  ==  (display-value mach "MACH" blink)
f-205  ==  (display-value roll "ROLL" blink)
f-206  ==  (display-value cone "CONE" blink)
f-207  ==  (display-value comfault "COMF" inverse)
f-208  ==  (display-value crew "CREW" inverse)
```

```
==> f-209   (display-value fail "FAIL" inverse)
==> f-210   (display-value deselect "DSEL" inverse)
==> f-211   (display-value off "OFF" inverse)
==> f-212   (display-value bad "BAD" inverse)
==> f-213   (display-value stopped "STOP" inverse)
CLIPS> (assert (single step))
==> f-214   (single step)
CLIPS> (run)
FIRE 1 control-kickoff: f-146
FIRE 2 control-change-phases: f-147 f-146
==> f-146   (phase fact-assertion)
==> f-215   (phase monitoring)
==> Activation 2 control-change-phases: f-148 f-215
FIRE 3 control-change-phases: f-148 f-215
==> f-215   (phase monitoring)
==> f-216   (phase analysis)
==> Activation 3 control-change-phases: f-149 f-216
FIRE 4 control-change-phases: f-149 f-216
==> f-216   (phase analysis)
==> f-217   (phase output)
==> Activation 4 control-change-phases: f-150 f-217
==> Activation 5 control-end-of-cycle: f-214 f-217
FIRE 5 control-end-of-cycle: f-214 f-217
5 rules fired
Run time is 1.2500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: output-event-recommendation
Excising rule: output-hold-recommendation
Excising rule: output-end-recommendation
Excising rule: output-update-status-light
CLIPS> (load "ban/tables")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-sres
CLIPS> (load "ban/control")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff+j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j+j
```

```
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "ban/runway.r")
Processing defacts block: monitoring-runway-phases
Processing defacts block: initial-runway-facts
Compiling rule: desired-runway-from-operator +j+j+j
Compiling rule: onboard-runway-correct =j+j+j=j+j+j
Compiling rule: onboard-runway-incorrect =j=j=j+j+j
Compiling rule: onboard-area-incorrect =j=j=j+j
Compiling rule: ground-runway-incorrect =j+j+j+j
CLIPS> (reset)
  f-0    >  == (initial-fact)
  f-1    >  == (common-lru p-1 2 3 1>)
  f-2    >  == (common-lru p-1-3 p-1-2 1>)
  f-3    >  == (common-lru p-2-3 p-1-2 2>)
  f-4    >  == (common-lru p-1-2 p-2-3 2>)
  f-5    >  == (common-lru p-1-2 p-2-3 3>)
  f-6    >  == (common-lru p-2-3 p-1-3 3>)
  f-7    >  == (excluded-lru p-1-2 3>)
  f-8    >  == (excluded-lru p-1-3 2>)
  f-9    >  == (excluded-lru p-2-3 1>)
  f-10   >  == (lrus-in-pair p-1-2 1 2>)
  f-11   >  == (lrus-in-pair p-1-2 2 1>)
  f-12   >  == (lrus-in-pair p-1-3 1 3>)
  f-13   >  == (lrus-in-pair p-1-3 3 1>)
  f-14   >  == (lrus-in-pair p-2-3 2 3>)
  f-15   >  == (lrus-in-pair p-2-3 3 2>)
  f-16   >  == (min-miscompare zero zero zero)
  f-17   >  == (min-miscompare under zero zero)
  f-18   >  == (min-miscompare o50 zero zero)
  f-19   >  == (min-miscompare over zero zero)
  f-20   >  == (min-miscompare zero under zero)
  f-21   >  == (min-miscompare zero under under)
  f-22   >  == (min-miscompare o50 under under)
  f-23   >  == (min-miscompare over under under)
  f-24   >  == (min-miscompare zero o50 zero)
  f-25   >  == (min-miscompare under o50 050)
  f-26   >  == (min-miscompare o50 o50 050)
  f-27   >  == (min-miscompare over o50 over)
  f-28   >  == (min-miscompare zero over zero)
  f-29   >  == (min-miscompare under over under)
  f-30   >  == (min-miscompare o50 over over)
  f-31   >  == (min-miscompare over over zero)
  f-32   >  == (max-miscompare zero zero zero)
  f-33   >  == (max-miscompare under zero under)
  f-34   >  == (max-miscompare o50 zero 050)
  f-35   >  == (max-miscompare over zero over)
  f-36   >  == (max-miscompare zero under under)
  f-37   >  == (max-miscompare under under under)
  f-38   >  == (max-miscompare o50 under o50)
  f-39   >  == (max-miscompare over under over)
  f-40   >  == (max-miscompare zero o50 050)
  f-41   >  == (max-miscompare under o50 050)
  f-42   >  == (max-miscompare o50 o50 050)
  f-43   >  == (max-miscompare over o50 over)
```

```
f-44  >> == (max-miscompare zero over over)
f-45  >> == (max-miscompare under over over)
f-46  >> == (max-miscompare o50 over over)
f-47  >> == (max-miscompare over over over)
f-48  >> == (fault-matrix o50 under under good)
f-49  >> == (fault-matrix o50 under under velocity)
f-50  >> == (fault-matrix over under under velocity)
f-51  >> == (fault-matrix under o50 under attitude)
f-52  >> == (fault-matrix under over under attitude)
f-53  >> == (fault-matrix under under o50 attitude)
f-54  >> == (fault-matrix under under over attitude)
f-55  >> == (fault-matrix o50 o50 under resolver)
f-56  >> == (fault-matrix over o50 under resolver)
f-57  >> == (fault-matrix o50 over under resolver)
f-58  >> == (fault-matrix over over under resolver)
f-59  >> == (fault-matrix o50 under o50 bias)
f-60  >> == (fault-matrix over under o50 bias)
f-61  >> == (fault-matrix o50 under over bias)
f-62  >> == (fault-matrix over under over bias)
f-63  >> == (fault-matrix under o50 o50 drift)
f-64  >> == (fault-matrix under over o50 drift)
f-65  >> == (fault-matrix under o50 over drift)
f-66  >> == (fault-matrix under over over drift)
f-67  >> == (fault-matrix o50 o50 o50 suspect)
f-68  >> == (fault-matrix over o50 o50 suspect)
f-69  >> == (fault-matrix o50 over o50 suspect)
f-70  >> == (fault-matrix over over o50 suspect)
f-71  >> == (fault-matrix o50 o50 over suspect)
f-72  >> == (fault-matrix over o50 over suspect)
f-73  >> == (fault-matrix o50 over over suspect)
f-74  >> == (fault-matrix over over over suspect)
f-75  >> == (quality-table zero good)
f-76  >> == (quality-table under good)
f-77  >> == (quality-table o50 suspect)
f-78  >> == (quality-table over bad)
f-79  >> == (tacan-quality under under under good)
f-80  >> == (tacan-quality under under over noise)
f-81  >> == (tacan-quality under o50 under bias)
f-82  >> == (tacan-quality under o50 over noise)
f-83  >> == (tacan-quality under over under bias)
f-84  >> == (tacan-quality under over over noise)
f-85  >> == (tacan-quality over under under timing)
f-86  >> == (tacan-quality over under over noise)
f-87  >> == (tacan-quality over o50 under timing)
f-88  >> == (tacan-quality over o50 over noise)
f-89  >> == (tacan-quality over over under timing)
f-90  >> == (tacan-quality over over over noise)
f-91  >> == (msbls-quality under under good)
f-92  >> == (msbls-quality under o50 good)
f-93  >> == (msbls-quality under over bad)
f-94  >> == (msbls-quality o50 under good)
f-95  >> == (msbls-quality o50 o50 good)
f-96  >> == (msbls-quality o50 over bad)
f-97  >> == (msbls-quality over under bad)
f-98  >> == (msbls-quality over o50 bad)
f-99  >> == (msbls-quality over over bad)
```

```
f-100    == >>    (measurement-name tacr range)
f-101    == >>    (measurement-name tacb bearing)
f-102    == >>    (measurement-name misr range)
f-103    == >>    (measurement-name misa azimuth)
f-104    == >>    (measurement-name mise elevation)
f-105    == >>    (units range feet)
f-106    == >>    (units bearing degrees)
f-107    == >>    (units azimuth degrees)
f-108    == >>    (units elevation degrees)
f-109    == >>    (units drag feet)
f-110    == >>    (units tacr feet)
f-111    == >>    (units baro feet)
f-112    == >>    (units misr feet)
f-113    == >>    (units tacb degrees)
f-114    == >>    (units misa degrees)
f-115    == >>    (units mise degrees)
f-116    == >>    (same-area 1 2)
f-117    == >>    (same-area 2 1)
f-118    == >>    (same-area 3 4)
f-119    == >>    (same-area 4 3)
f-120    == >>    (same-area 5 6)
f-121    == >>    (same-area 6 5)
f-122    == >>    (same-area 7 8)
f-123    == >>    (same-area 8 7)
f-124    == >>    (same-area 9 10)
f-125    == >>    (same-area 10 9)
f-126    == >>    (same-area 11 12)
f-127    == >>    (same-area 12 11)
f-128    == >>    (same-area 13 14)
f-129    == >>    (same-area 14 13)
f-130    == >>    (same-area 15 16)
f-131    == >>    (same-area 16 15)
f-132    == >>    (same-area 17 18)
f-133    == >>    (same-area 18 17)
f-134    == >>    (same-area 19 20)
f-135    == >>    (same-area 20 19)
f-136    == >>    (same-area 21 22)
f-137    == >>    (same-area 22 21)
f-138    == >>    (same-area 23 24)
f-139    == >>    (same-area 24 23)
f-140    == >>    (same-area 25 26)
f-141    == >>    (same-area 26 25)
f-142    == >>    (same-area 27 28)
f-143    == >>    (same-area 28 27)
f-144    == >>    (same-area 29 30)
f-145    == >>    (same-area 30 29)
f-146    == >>    (phase fact-assertion)
Activation  0 control-kickoff:  f-146
f-147    == >>    (next-phase fact-assertion monitoring)
Activation  1 control-change-phase:  f-147  f-146
f-148    == >>    (next-phase monitoring analysis)
f-149    == >>    (next-phase analysis output)
f-150    == >>    (next-phase output fact-assertion)
f-151    == >>    (first-sub-phase runway monitoring check)
f-152    == >>    (runway-status Pass unknown)
f-153    == >>    (runway-status Bfs unknown)
```

```
==> f-154    (runway-status ground unknown)
CLIPS> (assert (single-step))
==> f-155    (single-step)
CLIPS> (run)
FIRE  1 control-kickoff: f-146
FIRE  1 control-change-phases: f-147 f-146
<== f-146    (phase fact-assertion)
==> f-156    (phase monitoring)
==> Activation  2 control-kickoff-subphase:  f-156  f-151
==> Activation  3 control-change-phase:  f-156  f-149  f-151
FIRE  3 control-kickoff-subphase:  f-156  f-151
<== f-157    (sub-phase runway check)
==> Activation  4 control-last-subphase:  f-157
FIRE  4 control-last-subphase:  f-157
<== f-157    (sub-phase runway check)
FIRE  5 control-change-phases:  f-148  f-156
<== f-156    (phase monitoring)
==> f-158    (phase analysis)
==> Activation  5 control-change-phases:  f-149  f-158
FIRE  6 control-change-phases:  f-149  f-158
<== f-158    (phase analysis)
==> f-159    (phase output)
==> Activation  6 control-change-phases:  f-150  f-159
==> Activation  7 control-end-of-cycle:  f-155  f-159
FIRE  7 control-end-of-cycle:  f-155  f-159  f-159
pause 5 seconds
Run time is 0.7500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: desired-runway-from-operator
Excising rule: onboard-runway-correct
Excising rule: onboard-runway-incorrect
Excising rule: onboard-area-incorrect
Excising rule: ground-runway-incorrect
CLIPS> (load "ban/tables.n")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "ban/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
```

```
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS>(load "ban/state.r")
Processing deffacts block: monitoring-state-phases
Processing deffacts block: analysis-state-phases
Processing deffacts block: last-state-report
Compiling rule: state-error-change +j+j+j
Compiling rule: state-report-state-error =j+j+j+j+j+j+j+j
Compiling rule: state-pass-bfs-timing-problem =j+j+j+j+j
Compiling rule: state-pass-bfs-error-change =j+j+j+j+j
Compiling rule: state-report-pass-bfs-error =j=j+j+j+j+j+j
Compiling rule: state-need-delta-state +j+j+j+j
Compiling rule: state-ok-for-delta-state =j=j+j+j+j+j
Compiling rule: state-not-ok-for-delta-state =j=j=j=j+j
Compiling rule: state-inhibit-filter-processing =j+j+j+j+j
Compiling rule: state-delta-state-is-in-bfs =j+j+j
Compiling rule: state-need-transfer +j+j+j+j+j+j
=j=j=j=j+j+j
Compiling rule: state-transfer-in =j+j+j+j+j+j+j
Compiling rule: state-previous-pass-bfs-error-update =j+j+j+j+j+j
Compiling rule: state-transfer-cleanup =j+j+j
CLIPS>(reset)
==> f-0    (initial-fact)
==> f-1    (common-lru p-1-2 p-1-3 1)
==> f-2    (common-lru p-2-3 p-1-2 2)
==> f-3    (common-lru p-1-2 p-2-3 2)
==> f-4    (common-lru p-1-3 p-2-3 3)
==> f-5    (common-lru p-2-3 p-1-3 3)
==> f-6    (common-lru p-2-3 p-1-2 3)
==> f-7    (excluded-lru p-1-2 3)
==> f-8    (excluded-lru p-1-3 2)
==> f-9    (excluded-lru p-2-3 1)
==> f-10   (lrus-in-pair p-1-2 2)
==> f-11   (lrus-in-pair p-1-2 1)
==> f-12   (lrus-in-pair p-1-3 3)
==> f-13   (lrus-in-pair p-1-3 1)
==> f-14   (lrus-in-pair p-2-3 3)
==> f-15   (lrus-in-pair p-2-3 2)
==> f-16   (min-miscompare zero zero zero)
==> f-17   (min-miscompare under zero zero)
==> f-18   (min-miscompare o50 zero zero)
==> f-19   (min-miscompare over zero zero)
==> f-20   (min-miscompare zero under zero)
==> f-21   (min-miscompare under under zero)
==> f-22   (min-miscompare o50 under under)
==> f-23   (min-miscompare over under under)
==> f-24   (min-miscompare zero o50 zero)
==> f-25   (min-miscompare under o50 under)
==> f-26   (min-miscompare o50 o50 o50)
==> f-27   (min-miscompare over o50 o50)
==> f-28   (min-miscompare zero over zero)
```

```
f-29   (min-miscompare under over under)
f-30   (min-miscompare under over o50)
f-31   (min-miscompare over over o50)
f-32   (max-miscompare zero over zero)
f-33   (max-miscompare zero zero under)
f-34   (max-miscompare o50 zero o50)
f-35   (max-miscompare over zero over)
f-36   (max-miscompare zero under under)
f-37   (max-miscompare zero under under)
f-38   (max-miscompare o50 under under)
f-39   (max-miscompare o50 under o50)
f-40   (max-miscompare over under over)
f-41   (max-miscompare zero o50 o50)
f-42   (max-miscompare under o50 o50)
f-43   (max-miscompare over o50 over)
f-44   (max-miscompare under over over)
f-45   (max-miscompare o50 over over)
f-47   (max-miscompare over over over)
f-48   (fault-matrix under under under good)
f-49   (fault-matrix o50 under under velocity)
f-50   (fault-matrix over under under velocity)
f-51   (fault-matrix under o50 under attitude)
f-52   (fault-matrix under over under attitude)
f-53   (fault-matrix under under o50 attitude)
f-54   (fault-matrix under under over attitude)
f-55   (fault-matrix o50 o50 under resolver)
f-56   (fault-matrix over o50 under resolver)
f-57   (fault-matrix o50 over under resolver)
f-58   (fault-matrix over over under resolver)
f-59   (fault-matrix o50 under o50 bias)
f-60   (fault-matrix over under o50 bias)
f-61   (fault-matrix o50 under over bias)
f-62   (fault-matrix over under over bias)
f-63   (fault-matrix under o50 o50 drift)
f-64   (fault-matrix under over o50 drift)
f-65   (fault-matrix under o50 over drift)
f-66   (fault-matrix under over over drift)
f-67   (fault-matrix o50 o50 o50 suspect)
f-68   (fault-matrix over o50 o50 suspect)
f-69   (fault-matrix o50 over o50 suspect)
f-70   (fault-matrix over over o50 suspect)
f-71   (fault-matrix o50 o50 over suspect)
f-72   (fault-matrix over o50 over suspect)
f-73   (fault-matrix o50 over over suspect)
f-74   (fault-matrix over over over suspect)
f-75   (quality-table zero zero good)
f-76   (quality-table under good)
f-77   (quality-table o50 suspect)
f-78   (quality-table over bad)
f-79   (tacan-quality under under under good)
f-80   (tacan-quality under under over noise)
f-81   (tacan-quality under o50 under bias)
f-82   (tacan-quality under o50 over noise)
f-83   (tacan-quality under over under bias)
f-84   (tacan-quality under over over noise)
```

```
f-85    (tacan-quality over under under timing)
f-86    (tacan-quality over under over noise)
f-87    (tacan-quality over o50 under timing)
f-88    (tacan-quality over o50 over noise)
f-89    (tacan-quality over over under timing)
f-90    (tacan-quality over over over noise)
f-91    (msbls-quality under under good)
f-92    (msbls-quality under o50 good)
f-93    (msbls-quality under over bad)
f-94    (msbls-quality o50 under good)
f-95    (msbls-quality o50 o50 good)
f-96    (msbls-quality o50 over bad)
f-97    (msbls-quality over under bad)
f-98    (msbls-quality over o50 bad)
f-99    (msbls-quality over over bad)
f-100   (measurement-name tacr range)
f-101   (measurement-name tacb bearing)
f-102   (measurement-name misr range)
f-103   (measurement-name misa azimuth)
f-104   (measurement-name mise elevation)
f-105   (units range feet)
f-106   (units bearing degrees)
f-107   (units azimuth degrees)
f-108   (units elevation degrees)
f-109   (units drag feet)
f-110   (units tacr feet)
f-111   (units baro feet)
f-112   (units misr feet)
f-113   (units tacb degrees)
f-114   (units misa degrees)
f-115   (units mise degrees)
f-116   (same-area 1 2)
f-117   (same-area 2 1)
f-118   (same-area 3 4)
f-119   (same-area 4 3)
f-120   (same-area 5 6)
f-121   (same-area 6 5)
f-122   (same-area 7 8)
f-123   (same-area 8 7)
f-124   (same-area 9 10)
f-125   (same-area 10 19)
f-126   (same-area 11 12)
f-127   (same-area 12 11)
f-128   (same-area 13 14)
f-129   (same-area 14 13)
f-130   (same-area 15 16)
f-131   (same-area 16 15)
f-132   (same-area 17 18)
f-133   (same-area 18 17)
f-134   (same-area 19 20)
f-135   (same-area 20 19)
f-136   (same-area 21 22)
f-137   (same-area 22 21)
f-138   (same-area 23 24)
f-139   (same-area 24 23)
f-140   (same-area 25 26)
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```
==> f-141    (same-area 26 25)
==> f-142    (same-area 27 28)
==> f-143    (same-area 28 27)
==> f-144    (same-area 29 30)
==> f-145    (same-area 30 29)
==> f-146    (phase fact-assertion)
==> Activation    0 control-kickoff:  f-146
==> f-147    (next-phase fact-assertion monitoring)
==> Activation    1 control-change-phases:  f-147   f-146
==> f-148    (next-phase monitoring analysis)
==> f-149    (next-phase analysis output)
==> f-150    (next-phase output fact-assertion)
==> f-151    (first-sub-phase monitoring quality)
==> f-152    (first-sub-phase state analysis delta-state)
==> f-153    (next-sub-phase state delta-state bfs-transfer)
==> f-154    (last-state-report-with-hstd pass unknown 0)
==> f-155    (last-state-report-with-hstd bfs unknown 0)
==> f-156    (last-state-report-no-hstd unknown 0)
==> f-157    (previous-pass-bfs x unknown)
==> f-158    (previous-pass-bfs y unknown)
==> f-159    (previous-pass-bfs z unknown)
CLIPS> (assert (single step))
==> f-160 (single step)
CLIPS> (run)
FIRE    1 control-kickoff:  f-146
==  f-146    (control-change-phases:  f-147   f-146
FIRE    2 control-change-phases:  f-147   f-146
==> f-146    (phase fact-assertion)
==> f-161    (phase monitoring)
==> Activation    2 control-kickoff-subphase:  f-161   f-151
FIRE    3 control-kickoff-subphase:  f-161   f-151
==> f-162    (sub-phase state quality)
==> Activation    4 control-last-subphase:  f-162
FIRE    4 control-last-subphase:  f-162
==  f-162    (sub-phase state quality)  f-162
FIRE    5 control-change-phases:  f-148   f-161
==  f-161    (phase monitoring)
==> f-163    (phase analysis)
==> Activation    5 control-kickoff-subphase:  f-163   f-152
==> Activation    6 control-change-phases:  f-149   f-163
FIRE    6 control-kickoff-subphase:  f-163   f-152
==> f-164    (sub-phase state delta-state)
==> Activation    7 control-last-subphase:  f-164   f-153
==> Activation    8 control-next-subphase:  f-164   f-153
FIRE    7 control-next-subphase:  f-164   f-153
==  f-164    (sub-phase state delta-state)
==> f-165    (sub-phase state bfs-transfer)
==> Activation    9 control-last-subphase:  f-165
FIRE    8 control-last-subphase:  f-165
==  f-165    (sub-phase state bfs-transfer)
FIRE    9 control-change-phases:  f-149   f-163
==  f-163    (phase analysis)
==> f-166    (phase output)
==> Activation   10 control-change-phases:  f-150   f-166
==> Activation   11 control-end-of-cycle:  f-160   f-166
```

```
FIRE 10 control-end-of-cycle: f-160 f-160
10 rules fired
Run time is 2.7500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: state-error-change
Excising rule: state-report-state-error
Excising rule: state-pass-bfs-timing-problem
Excising rule: state-pass-bfs-error-change
Excising rule: state-report-pass-bfs-error
Excising rule: state-need-delta-state
Excising rule: state-ok-for-delta-state
Excising rule: state-not-ok-for-delta-state
Excising rule: state-inhibit-filter-processing
Excising rule: state-delta-state-is-in-bfs
Excising rule: state-need-transfer
Excising rule: state-not-transfer-in
Excising rule: state-previous-pass-bfs-error-update
Excising rule: state-transfer-cleanup
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
Processing deffacts block: tables-same-area
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j
CLIPS> (load "Dan/tacan.r")
Processing deffacts block: monitoring-tacan-phases
Processing deffacts block: analysis-tacan-phases
Compiling rule: tacan-skip-tacan +j+j+j
Compiling rule: tacan-channel-changed =j+j+j+j+j
Compiling rule: tacan-toggle-tacan-due-to-wrong-channel =j+j+j+j+j
Compiling rule: tacan-gpc-mode =j=j=j+j+j+j
Compiling rule: tacan-fix-lru-channel =j=j+j+j+j
Compiling rule: tacan-config-is-good =j=j=j+j+j+j
```

```
Compiling rule: tacan-commfault +j+j+j+j+j
Compiling rule: tacan-commfault-clear =j+j+j+j+j+j
Compiling rule: tacan-deselect =j+j+j+j+j
Compiling rule: tacan-power-off =j+j+j+j+j
Compiling rule: tacan-power-on =j+j+j+j+j+j+j
Compiling rule: tacan-failed =j+j+j+j+j+j+j+j+j
Compiling rule: tacan-reselected =j+j+j+j+j+j+j
Compiling rule: tacan-locked =j+j+j
Compiling rule: tacan-no-locked =j+j+j+j
Compiling rule: tacan-one-of-confusion-on-ignore-bearing +j+j
Compiling rule: tacan-no-quality-due-to-channel-change =j+j+j+j
Compiling rule: tacan-use-gnd-minus-ob-errors =j+j+j+j+j
Compiling rule: tacan-use-relative-errors =j+j+j+j+j+j
Compiling rule: tacan-no-quality-rating-part-1 =j+j+j+j+j
=j=j+j+j
Compiling rule: tacan-no-quality-rating-part-2 =j+j+j+j+j+j+j
=j=j+j+j+j
=j+j+j+j
Compiling rule: tacan-temporary-quality-for-noise-bias-slope =j+j+j+j+j
=j=j+j+j+j
Compiling rule: tacan-determine-lru-rating-part-1 =j+j+j+j
Compiling rule: tacan-determine-lru-rating-part-2 =j+j+j+j+j+j+j+j+j
Compiling rule: tacan-determine-lru-rating-part-3 =j+j+j+j+j+j+j+j+j+j+j
Compiling rule: tacan-determine-lru-rating-part-4 =j=j=j=j=j=j=j+j+j+j+j+j+j
=j=j=j+j+j+j
Compiling rule: tacan-determine-lru-rating-part-5 =j=j=j=j=j=j+j+j+j+j+j
=j=j=j+j+j+j
=j+j+j
Compiling rule: tacan-quality-rating-change =j+j+j+j+j
Compiling rule: tacan-dilemma-cleanup +j+j
Compiling rule: tacan-temporary-rating-cleanup =j+j
Compiling rule: tacan-filter-flag-changed =j+j+j+j
Compiling rule: tacan-end-measurement-processing =j=j+j+j+j+j
=j+j+j+j
Compiling rule: tacan-data-good-flag-changed =j=j+j+j+j+j
Compiling rule: tacan-dilemma-occurred =j+j
Compiling rule: tacan-gnd-station-problem-1 +j+j+j+j+j+j
=j=j=j+j+j+j
Compiling rule: tacan-gnd-station-problem-2 =j=j+j+j+j+j+j+j
Compiling rule: tacan-one-locked-at-130k =j+j+j+j+j+j
Compiling rule: tacan-none-locked-at-130k =j+j+j+j+j
Compiling rule: tacan-do-a-toggle +j+j+j
Compiling rule: tacan-dont-do-a-toggle =j+j
Compiling rule: tacan-kill-old-suggestion +j+j+j
Compiling rule: tacan-dsel-prep-done =j+j+j
Compiling rule: tacan-dilemma =j+j+j+j+j+j
Compiling rule: tacan-two-against-one =j+j+j+j+j+j+j
Compiling rule: tacan-not-2-locked =j+j+j+j+j+j+j
Compiling rule: tacan-noisy-lru =j+j
Compiling rule: tacan-rm-failed-wrong-lru =j=j+j+j+j
Compiling rule: tacan-deselect-the-lru-due-to-no-go =j+j+j+j+j+j
Compiling rule: tacan-try-zero-deselects =j+j
Compiling rule: tacan-try-one-deselect =j+j+j
```

```
Compiling rule: tacan-try-two-deselects =j=j+j+j+j
Compiling rule: tacan-eliminate-duplicate-configurations =j+j+j+j+j+j+j
Compiling rule: tacan-predict-available =j=j+j+j
Compiling rule: tacan-predict-not-available-1 =j=j+j
Compiling rule: tacan-predict-not-available-2 =j=j+j+j
Compiling rule: tacan-predict-data-good-two-locked =j=j+j+j+j
Compiling rule: tacan-predict-data-good-one-locked =j=j+j+j+j
Compiling rule: tacan-predict-data-good-one-avail =j=j+j+j+j
Compiling rule: tacan-predict-data-good-off =j+j+j
Compiling rule: tacan-predict-dilemma =j=j+j+j+j+j+j+j
=j=j+j=j+j+j
Compiling rule: tacan-predict-no-dilemma =j=j+j
Compiling rule: tacan-predict-error-1-level =j+j+j+j+j+j+j
=j=j=j+j+j+j
=j=j=j+j+j
=j=j=j+j+j
Compiling rule: tacan-predict-error-2-level =j=j=j+j+j+j+j+j+j
=j=j=j+j+j
Compiling rule: tacan-predict-error-3-level =j=j+j+j+j+j+j+j
Compiling rule: tacan-dont-want-dilemma =j+j
Compiling rule: tacan-need-range-data =j+j
Compiling rule: tacan-dont-have-bearing =j+j
Compiling rule: tacan-predict-state-effect =j+j+j+j+j+j
Compiling rule: tacan-pick-smallest-state-effect =j+j+j
Compiling rule: tacan-select-a-configuration =j+j
Compiling rule: tacan-confirm-a-deselect =j+j
Compiling rule: tacan-deny-a-deselect =j=j+j
Compiling rule: tacan-deselect-confirmed =j+j
Compiling rule: tacan-deselect-shortcut =j+j
Compiling rule: tacan-deselect-cleanup =j+j
Compiling rule: tacan-reselect-a-tacan +j+j+j+j+j+j
Compiling rule: tacan-selected-tacan-is-acceptable +j+j+j+j+j+j+j+j+j+j
```

```
=j=j=j=j+j
=j=j=j=j+j+j
Compiling rule: tacan-selected-tacan-is-unacceptable =j=j+j+j+j+j
Compiling rule: tacan-to-auto =j+j+j+j+j+j+j+j+j+j
Compiling rule: tacan-to-auto-no-bearing =j=j+j+j+j+j+j+j+j
Compiling rule: tacan-to-auto-and-force =j+j+j+j+j+j+j+j+j
Compiling rule: tacan-auto-after-update =j=j+j+j+j+j+j+j+j
Compiling rule: tacan-inhibit-bad-tacan =j=j+j+j+j+j+j+j
=j=j=j=j+j+j
Compiling rule: tacan-error-before-tacan =j=j+j+j+j+j+j
Compiling rule: tacan-error-after-tacan =j=j+j+j+j+j
Compiling rule: tacan-to-force =j=j=j+j+j+j+j+j+j
CLIPS> (reset)
==> f-0    (initial-fact)
==> f-1    (common-lru p-1-2 p-1-3 1 )
==> f-2    (common-lru p-1-3 p-1-2 1 )
==> f-3    (common-lru p-2-3 p-1-2 2 )
==> f-4    (common-lru p-1-3 p-2-3 3 )
==> f-5    (common-lru p-1-3 p-2-3 3 )
==> f-6    (common-lru p-2-3 p-1-3 3 )
==> f-7    (excluded-lru p-1-2 3 )
==> f-9    (excluded-lru p-2-3 1 )
==> f-10   (excluded-lru p-2-3 1 )
==> f-11   (lrus-in-pair p-1-2 1 2 )
==> f-12   (lrus-in-pair p-1-2 1 3 )
==> f-13   (lrus-in-pair p-1-3 1 3 )
==> f-14   (lrus-in-pair p-2-3 2 3 )
==> f-15   (lrus-in-pair p-2-3 2 3 )
==> f-18   (lrus-in-pair p-2-3 2 )
==> f-19   (min-miscompare zero zero zero )
==> f-20   (min-miscompare under zero zero )
==> f-21   (min-miscompare o50 zero zero )
==> f-22   (min-miscompare over zero zero )
==> f-23   (min-miscompare zero under zero )
==> f-24   (min-miscompare under under under )
==> f-25   (min-miscompare o50 under under )
==> f-26   (min-miscompare over under under )
==> f-27   (min-miscompare zero o50 zero )
==> f-28   (min-miscompare under o50 under )
==> f-29   (min-miscompare o50 o50 o50 )
==> f-30   (min-miscompare over o50 over )
==> f-31   (min-miscompare zero over zero )
==> f-32   (min-miscompare under over under )
==> f-33   (min-miscompare o50 over o50 )
==> f-34   (min-miscompare over over over )
==> f-35   (max-miscompare zero zero zero )
==> f-36   (max-miscompare under zero under )
==> f-37   (max-miscompare o50 zero o50 )
==> f-38   (max-miscompare over zero over )
==> f-39   (max-miscompare zero under under )
==> f-40   (max-miscompare under under under )
==> f-41   (max-miscompare o50 under o50 )
==> f-42   (max-miscompare over under over )
```

```
f-43 => (max-miscompare over o50 over)
f-44 => (max-miscompare zero over over)
f-45 => (max-miscompare under over over)
f-46 => (max-miscompare o50 over over)
f-47 => (max-miscompare over over over)
f-48 => (fault-matrix under under under good)
f-49 => (fault-matrix o50 under under velocity)
f-50 => (fault-matrix over under under velocity)
f-51 => (fault-matrix under o50 under attitude)
f-52 => (fault-matrix under over under attitude)
f-53 => (fault-matrix under under o50 attitude)
f-54 => (fault-matrix under under over attitude)
f-55 => (fault-matrix o50 o50 under resolver)
f-56 => (fault-matrix over o50 under resolver)
f-57 => (fault-matrix o50 over under resolver)
f-58 => (fault-matrix over over under resolver)
f-59 => (fault-matrix under o50 bias)
f-60 => (fault-matrix over under o50 bias)
f-61 => (fault-matrix o50 under over bias)
f-62 => (fault-matrix over under over bias)
f-63 => (fault-matrix under o50 o50 drift)
f-64 => (fault-matrix under over o50 drift)
f-65 => (fault-matrix under o50 over drift)
f-66 => (fault-matrix o50 over over drift)
f-67 => (fault-matrix over over over drift)
f-68 => (fault-matrix o50 o50 o50 suspect)
f-69 => (fault-matrix over o50 o50 suspect)
f-70 => (fault-matrix o50 over o50 suspect)
f-71 => (fault-matrix over over o50 suspect)
f-72 => (fault-matrix o50 o50 over suspect)
f-73 => (fault-matrix over o50 over suspect)
f-74 => (fault-matrix o50 over over suspect)
f-75 => (fault-matrix over over over suspect)
f-76 => (quality-table zero good)
f-77 => (quality-table under good)
f-78 => (quality-table o50 suspect)
f-79 => (quality-table over bad)
f-80 => (tacan-quality under under under good)
f-81 => (tacan-quality under under over noise)
f-82 => (tacan-quality under o50 under bias)
f-83 => (tacan-quality under o50 over noise)
f-84 => (tacan-quality under over under bias)
f-85 => (tacan-quality under over over noise)
f-86 => (tacan-quality o50 under under timing)
f-87 => (tacan-quality o50 under over noise)
f-88 => (tacan-quality o50 over under timing)
f-89 => (tacan-quality o50 over over noise)
f-90 => (tacan-quality over over over noise)
f-91 => (tacan-quality over under under timing)
f-92 => (msbls-quality under under under good)
f-93 => (msbls-quality under o50 over good)
f-94 => (msbls-quality under over bad)
f-95 => (msbls-quality o50 under good)
f-96 => (msbls-quality o50 o50 good)
f-97 => (msbls-quality over under bad)
f-98 => (msbls-quality over o50 bad)
```

```
f-99   > = (msbls-quality over over bad)
f-100  > = (measurement-name tacr range)
f-101  > = (measurement-name tacb bearing)
f-102  > = (measurement-name misr range)
f-103  > = (measurement-name misa azimuth)
f-104  > = (measurement-name mise elevation)
f-105  > = (units range feet)
f-106  > = (units bearing degrees)
f-107  > = (units azimuth degrees)
f-108  > = (units elevation degrees)
f-109  > = (units drag feet)
f-110  > = (units tacr feet)
f-111  > = (units baro feet)
f-112  > = (units misr feet)
f-113  > = (units tacb degrees)
f-114  > = (units misa degrees)
f-115  > = (units mise degrees)
f-116  > = (same-area 1 2)
f-117  > = (same-area 2 1)
f-118  > = (same-area 3 4)
f-119  > = (same-area 4 3)
f-120  > = (same-area 5 6)
f-121  > = (same-area 6 5)
f-122  > = (same-area 7 8)
f-123  > = (same-area 8 7)
f-124  > = (same-area 9 10)
f-125  > = (same-area 10 9)
f-126  > = (same-area 11 12)
f-127  > = (same-area 12 11)
f-128  > = (same-area 13 14)
f-129  > = (same-area 14 13)
f-130  > = (same-area 15 16)
f-131  > = (same-area 16 15)
f-132  > = (same-area 17 18)
f-133  > = (same-area 18 17)
f-134  > = (same-area 19 20)
f-135  > = (same-area 20 19)
f-136  > = (same-area 21 22)
f-137  > = (same-area 22 21)
f-138  > = (same-area 23 24)
f-139  > = (same-area 24 23)
f-140  > = (same-area 25 26)
f-141  > = (same-area 26 25)
f-142  > = (same-area 27 28)
f-143  > = (same-area 28 27)
f-144  > = (same-area 29 30)
f-145  > = (same-area 30 29)
f-146  > = (phase fact-assertion)
Activation 0 control-kickoff; f-146
f-147  > = (next-phase fact-assertion monitoring)
Activation 1 control-change-phase; f-146 f-146
f-148  > = (next-phase monitoring analysis)
f-149  > = (next-phase analysis output)
f-150  > = (next-phase output fact-assertion)
f-151  > = (first-sub-phase tacan monitoring configuration)
f-152  > = (next-sub-phase tacan configuration availability)
```

```
==> f-153   (next-sub-phase tacan availability quality-rating)
==> f-154   (next-sub-phase tacan quality-rating quality)
==> f-155   (next-sub-phase tacan quality match-flag)
==> f-156   (first-sub-phase tacan analysis toggle)
==> f-157   (next-sub-phase tacan toggle deselect)
==> f-158   (next-sub-phase tacan deselect clean-up)
==> f-159   (next-sub-phase tacan clean-up reselect)
==> f-160   (next-sub-phase tacan reselect aif-change)
==> f-161   (tacan-status pass 1 range avail)
==> f-162   (tacan-status pass 1 bearing avail)
==> f-163   (tacan-status pass 2 range avail)
==> f-164   (tacan-status pass 2 bearing avail)
==> f-165   (tacan-status pass 3 range avail)
==> f-166   (tacan-status pass 3 bearing avail)
==> f-167   (tacan-status bfs 1 range avail)
==> f-168   (tacan-status bfs 1 bearing avail)
==> f-169   (tacan-status bfs 2 range avail)
==> f-170   (tacan-status bfs 2 bearing avail)
==> f-171   (tacan-status bfs 3 range avail)
==> f-172   (tacan-status bfs 3 bearing avail)
==> f-173   (tacan-lru-quality 1 range none)
==> f-174   (tacan-lru-quality 1 bearing none)
==> f-175   (tacan-lru-quality 2 range none)
==> f-176   (tacan-lru-quality 2 bearing none)
==> f-177   (tacan-lru-quality 3 range none)
==> f-178   (tacan-lru-quality 3 bearing none)
==> f-179   (prev-tacan-channel 1 -999)
==> f-180   (prev-tacan-channel 2 -999)
==> f-181   (prev-tacan-channel 3 -999)
==> f-182   (prev-tacan-lock range off)
==> f-183   (prev-tacan-lock bearing off)
==> f-184   (prev-filter-flag pass tacr off)
==> f-185   (prev-filter-flag pass tacb off)
==> f-186   (prev-filter-flag bfs tacr off)
==> f-187   (prev-filter-flag bfs tacb off)
==> f-188   (prev-data-good pass tacr off)
==> f-189   (prev-data-good pass tacb off)
==> f-190   (prev-data-good bfs tacr off)
==> f-191   (prev-data-good bfs tacb off)
==> f-192   (last-tacan-quality 1 range unknown)
==> f-193   (last-tacan-quality 1 bearing unknown)
==> f-194   (last-tacan-quality 2 range unknown)
==> f-195   (last-tacan-quality 2 bearing unknown)
==> f-196   (last-tacan-quality 3 range unknown)
==> f-197   (last-tacan-quality 3 bearing unknown)
==> f-198   (selected channel 0)
==> f-199   (error-before-tacan unknown)
==> f-200   (selected-tacan range no-go)
==> f-201   (selected-tacan bearing no-go)
CLIPS> (assert (single-step))
CLIPS> (run)
FIRE  1 control-kickoff: f-146
FIRE  2 control-change-phase: f-147 f-148
<== f-146   (phase fact-assertion)
==> f-203   (phase monitoring)
```

```
==> Activation      2 control-kickoff-subphase:      f-203  f-151
==^ Activation      3 control-change-phase:  f-148  f-203
FIRE   3 control-kickoff-subphase:  f-203   f-151
==> f-204  (sub-phase tacan configuration)
==^ Activation      4 control-last-subphase:  f-204   f-152
==> Activation      5 control-next-subphase:  f-204  f-152
FIRE   4 control-next-subphase:  f-204  f-152
==> f-204  (sub-phase tacan configuration)
==^ Activation      4 control-last-subphase:   f-204
==> f-205  (sub-phase tacan availability)
==> Activation      6 control-last-subphase:  f-205
==> Activation      7 control-next-subphase:  f-205  f-153
FIRE   5 control-next-subphase:     f-205  f-153
==> f-205  (sub-phase tacan availability)
==> Activation      6 control-last-subphase:  f-205
==> f-206  (sub-phase tacan quality-rating)
==> Activation      8 control-last-subphase:  f-206
==> Activation      9 control-next-subphase:  f-206  f-154
FIRE   6 control-next-subphase:  f-206  f-154
==> f-206  (sub-phase tacan quality-rating)
==> Activation      8 control-last-subphase:  f-206
==> f-207  (sub-phase tacan quality)
==> Activation     10 control-last-subphase:  f-207  f-155
==> Activation     11 control-next-subphase:  f-207  f-155
FIRE   7 control-next-subphase:  f-207  f-155
==> f-207  (sub-phase tacan quality)
==> Activation     10 control-last-subphase:  f-207
==> f-208  (sub-phase tacan watch-flags)
==> Activation     12 control-last-subphase:  f-208
FIRE   8 control-last-subphase:  f-208
==> f-208  (sub-phase tacan watch-flags)
==> Activation      9 control-change-phases:  f-148  f-203
FIRE   9 control-change-phases:  f-148  f-203
==> f-209  (phase monitoring)
==> f-209  (phase analysis)
==> Activation     13 control-kickoff-subphase:   f-209  f-156
==> Activation     14 control-change-phase:  f-149  f-209
FIRE  10 control-kickoff-subphase:  f-209  f-156
==> f-210  (sub-phase tacan toggle)
==> Activation     15 control-last-subphase:  f-210  f-157
==> Activation     16 control-next-subphase:  f-210  f-157
FIRE  11 control-next-subphase:  f-210  f-157
==> f-210  (sub-phase tacan toggle)
==> Activation     15 control-last-subphase:  f-210
==> f-211  (sub-phase tacan deselect)
==> Activation     17 control-last-subphase:  f-211
FIRE  12 control-last-subphase:  f-211  f-158
==> f-211  (sub-phase tacan deselect)
==> Activation     17 control-last-subphase:  f-211
==> f-212  (sub-phase tacan clean-up)
==> Activation     19 control-last-subphase:  f-212
==> Activation     20 control-next-subphase:  f-212  f-159
FIRE  13 control-next-subphase:  f-212  f-159
==> f-212  (sub-phase tacan clean-up)
==> Activation     19 control-last-subphase:  f-212
==> f-213  (sub-phase tacan reselect)
```

```
==> Activation 21 control-last-subphase: f-213
==> Activation 22 control-next-subphase: f-213 f-160
FIRE 14 control-next-subphase: f-213 f-160
==> f-213 (sub-phase tacan reselect)
==> Activation 21 control-last-subphase: f-213
==> f-214 (sub-phase tacan aif-change)
==> Activation 23 control-last-subphase: f-214
FIRE 15 control-last-subphase: f-214
<== f-214 (sub-phase tacan aif-change)
FIRE 16 control-change-phases: f-149 f-209
<== f-209 (phase analysis)
==> f-215 (phase output)
==> Activation 24 control-change-phases: f-150 f-215
==> Activation 25 control-end-of-cycle: f-202 f-215
FIRE 17 control-end-of-cycle: f-202 f-215
17 rules fired
Run time is 4.0000 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
Excising rule: tacan-skip-tacan
Excising rule: tacan-channel-changed
Excising rule: tacan-toggle-tacan-due-to-wrong-channel
Excising rule: tacan-gpc-mode
Excising rule: tacan-fix-lru-channel
Excising rule: tacan-config-is-good
Excising rule: tacan-commfault
Excising rule: tacan-commfault-clear
Excising rule: tacan-deselect
Excising rule: tacan-power-off
Excising rule: tacan-power-on
Excising rule: tacan-failed
Excising rule: tacan-reselected
Excising rule: tacan-locked
Excising rule: tacan-no-locked
Excising rule: tacan-cone-of-confusion-on-ignore-bearing
Excising rule: tacan-no-quality-due-to-channel-change
Excising rule: tacan-use-gnd-minus-ob-errors
Excising rule: tacan-use-relative-errors
Excising rule: tacan-no-quality-lru-rating-part-1
Excising rule: tacan-no-quality-lru-rating-part-2
Excising rule: tacan-temporary-quality-for-noise-bias-slope
Excising rule: tacan-determine-lru-rating-part-1
Excising rule: tacan-determine-lru-rating-part-2
Excising rule: tacan-determine-lru-rating-part-3
Excising rule: tacan-determine-lru-rating-part-4
Excising rule: tacan-determine-lru-rating-part-5
Excising rule: tacan-quality-rating-change
Excising rule: tacan-dilemma-cleanup
Excising rule: tacan-temporary-rating-cleanup
Excising rule: tacan-filter-flag-changed
Excising rule: tacan-end-measurement-processing
```

```
Excising rule: tacan-data-good-flag-changed
Excising rule: tacan-dilemma-occurred
Excising rule: tacan-gnd-station-problem-1
Excising rule: tacan-gnd-station-problem-2
Excising rule: tacan-one-locked-at-130k
Excising rule: tacan-none-locked-at-130k
Excising rule: tacan-do-a-toggle
Excising rule: tacan-dont-do-a-toggle
Excising rule: tacan-kill-old-suggestion
Excising rule: tacan-dsel-prep-done
Excising rule: tacan-dilemma
Excising rule: tacan-two-against-one
Excising rule: tacan-not-2-locked
Excising rule: tacan-noisy-lru
Excising rule: tacan-rm-failed-wrong-lru
Excising rule: tacan-deselect-the-lru-due-to-no-go
Excising rule: tacan-try-zero-deselects
Excising rule: tacan-try-one-deselect
Excising rule: tacan-try-two-deselects
Excising rule: tacan-eliminate-duplicate-configurations
Excising rule: tacan-predict-available
Excising rule: tacan-predict-not-available-1
Excising rule: tacan-predict-not-available-2
Excising rule: tacan-predict-data-good-two-locked
Excising rule: tacan-predict-data-good-one-locked
Excising rule: tacan-predict-data-good-one-avail
Excising rule: tacan-predict-data-good-off
Excising rule: tacan-predict-dilemma
Excising rule: tacan-predict-no-dilemma
Excising rule: tacan-predict-error-1-level
Excising rule: tacan-predict-error-2-level
Excising rule: tacan-predict-error-3-level
Excising rule: tacan-dont-want-dilemma
Excising rule: tacan-need-range-data
Excising rule: tacan-dont-have-bearing
Excising rule: tacan-predict-state-effect
Excising rule: tacan-pick-smallest-state-effect
Excising rule: tacan-select-a-configuration
Excising rule: tacan-confirm-a-deselect
Excising rule: tacan-deny-a-deselect
Excising rule: tacan-deselect-confirmed
Excising rule: tacan-deselect-shortcut
Excising rule: tacan-deselect-cleanup
Excising rule: tacan-reselect-a-tacan
Excising rule: tacan-selected-tacan-is-acceptable
Excising rule: tacan-selected-tacan-is-unacceptable
Excising rule: tacan-to-auto
Excising rule: tacan-to-auto-no-bearing
Excising rule: tacan-to-auto-end-force
Excising rule: tacan-auto-after-update
Excising rule: tacan-inhibit-bad-tacan
Excising rule: tacan-error-before-tacan
Excising rule: tacan-error-after-tacan
Excising rule: tacan-to-force
CLIPS> (load "Dan/tables.r")
Processing deffacts block: tables-common-lru
```

```
Processing deffacts block: tables-excluded-lru
Processing deffacts block: tables-lrus-in-pair
Processing deffacts block: tables-min-miscompare
Processing deffacts block: tables-max-miscompare
Processing deffacts block: tables-fault-matrix
Processing deffacts block: tables-quality-table
Processing deffacts block: tables-tacan-quality
Processing deffacts block: tables-msbls-quality
Processing deffacts block: tables-measurement-names
Processing deffacts block: tables-units
CLIPS> (load "Dan/control.r")
Processing deffacts block: control-initial-phase
Processing deffacts block: control-phases
Compiling rule: control-kickoff +j
Compiling rule: control-change-phases +j+j+j
Compiling rule: control-end-of-cycle +j+j+j
Compiling rule: control-kickoff-subphase +j+j
Compiling rule: control-next-subphase +j+j
Compiling rule: control-last-subphase +j
CLIPS> (load "Dan/telemetry.r")
CLIPS> (reset)
==> f-0    (initial-fact)
==> f-1    (common-lru p-1-2 p-1-3 1)
==> f-2    (common-lru p-1-3 p-1-2 1)
==> f-3    (common-lru p-2-1 p-2-3 2)
==> f-4    (common-lru p-2-1 p-1-2 1)
==> f-5    (common-lru p-1-2 p-2-1 1)
==> f-6    (common-lru p-2-3 p-2-1 2)
==> f-7    (excluded-lru p-1-3 3)
==> f-8    (excluded-lru p-1-3 3)
==> f-9    (excluded-lru p-1-3 3)
==> f-10   (lrus-in-pair p-1-2 2)
==> f-11   (lrus-in-pair p-1-3 2)
==> f-12   (lrus-in-pair p-1-3 3)
==> f-13   (lrus-in-pair p-2-1 2)
==> f-14   (lrus-in-pair p-2-3 3)
==> f-15   (lrus-in-pair p-2-3 2)
==> f-16   (min-miscompare zero zero zero)
==> f-17   (min-miscompare under zero zero)
==> f-18   (min-miscompare 050 zero zero)
==> f-19   (min-miscompare over zero zero)
==> f-20   (min-miscompare zero under zero)
==> f-21   (min-miscompare under under zero)
==> f-22   (min-miscompare 050 under zero)
==> f-23   (min-miscompare over under under)
==> f-24   (min-miscompare zero 050 zero)
==> f-25   (min-miscompare under 050 zero)
==> f-26   (min-miscompare 050 050 050)
==> f-27   (min-miscompare over 050 050)
==> f-28   (min-miscompare zero over zero)
==> f-29   (min-miscompare under over zero)
==> f-30   (min-miscompare 050 over 050)
==> f-31   (min-miscompare over over over)
==> f-32   (max-miscompare zero zero zero)
==> f-33   (max-miscompare under zero under)
```

```
==> ^^^ f-34  (max-miscompare o50 zero o50)
==> ^^^ f-35  (max-miscompare over zero over)
==> ^^^ f-36  (max-miscompare zero under under)
==> ^^^ f-37  (max-miscompare zero under under)
==> ^^^ f-38  (max-miscompare o50 under o50)
==> ^^^ f-39  (max-miscompare over under over)
==> ^^^ f-40  (max-miscompare zero o50 o50)
==> ^^^ f-41  (max-miscompare under o50 o50)
==> ^^^ f-42  (max-miscompare o50 o50 o50)
==> ^^^ f-43  (max-miscompare zero over over)
==> ^^^ f-44  (max-miscompare zero over over)
==> ^^^ f-45  (max-miscompare under over over)
==> ^^^ f-46  (max-miscompare o50 over over)
==> ^^^ f-47  (max-miscompare over over over)
==> ^^^ f-48  (fault-matrix under under under good)
==> ^^^ f-49  (fault-matrix o50 under under velocity)
==> ^^^ f-50  (fault-matrix over under under velocity)
==> ^^^ f-51  (fault-matrix o50 over under attitude)
==> ^^^ f-52  (fault-matrix under over under attitude)
==> ^^^ f-53  (fault-matrix under under o50 attitude)
==> ^^^ f-54  (fault-matrix under under over attitude)
==> ^^^ f-55  (fault-matrix o50 o50 under resolver)
==> ^^^ f-56  (fault-matrix over o50 under resolver)
==> ^^^ f-57  (fault-matrix o50 over under resolver)
==> ^^^ f-58  (fault-matrix over over under resolver)
==> ^^^ f-59  (fault-matrix o50 under o50 bias)
==> ^^^ f-60  (fault-matrix over under o50 bias)
==> ^^^ f-61  (fault-matrix o50 under over bias)
==> ^^^ f-62  (fault-matrix over under over bias)
==> ^^^ f-63  (fault-matrix under o50 o50 drift)
==> ^^^ f-64  (fault-matrix under over o50 drift)
==> ^^^ f-65  (fault-matrix under o50 over drift)
==> ^^^ f-66  (fault-matrix under over over drift)
==> ^^^ f-67  (fault-matrix o50 o50 o50 suspect)
==> ^^^ f-68  (fault-matrix over o50 o50 suspect)
==> ^^^ f-69  (fault-matrix o50 over o50 suspect)
==> ^^^ f-70  (fault-matrix over over o50 suspect)
==> ^^^ f-71  (fault-matrix o50 o50 over suspect)
==> ^^^ f-72  (fault-matrix over o50 over suspect)
==> ^^^ f-73  (fault-matrix o50 over over suspect)
==> ^^^ f-74  (fault-matrix over over over suspect)
==> ^^^ f-75  (quality-table zero zero good)
==> ^^^ f-76  (quality-table under under good)
==> ^^^ f-77  (quality-table o50 suspect)
==> ^^^ f-78  (quality-table over over bad)
==> ^^^ f-79  (tacan-quality under under under good)
==> ^^^ f-80  (tacan-quality under under over noise)
==> ^^^ f-81  (tacan-quality under o50 under bias)
==> ^^^ f-82  (tacan-quality under o50 over noise)
==> ^^^ f-83  (tacan-quality under over under bias)
==> ^^^ f-84  (tacan-quality under over over noise)
==> ^^^ f-85  (tacan-quality over under under timing)
==> ^^^ f-86  (tacan-quality over under over noise)
==> ^^^ f-87  (tacan-quality over o50 under timing)
==> ^^^ f-88  (tacan-quality over o50 over noise)
==> ^^^ f-89  (tacan-quality over over under timing)
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==> || f-90   (tacan-quality over over over noise)
==> || f-91   (msbls-quality under under under good)
==> || f-92   (msbls-quality under o50 good)
==> || f-93   (msbls-quality under over bad)
==> || f-94   (msbls-quality o50 under good)
==> || f-95   (msbls-quality o50 o50 good)
==> || f-96   (msbls-quality o50 over bad)
==> || f-97   (msbls-quality over under bad)
==> || f-98   (msbls-quality over o50 bad)
==> || f-99   (msbls-quality over over bad)
==> || f-100  (measurement-name tacr range)
==> || f-101  (measurement-name tacb bearing)
==> || f-102  (measurement-name mlsr range)
==> || f-103  (measurement-name mlsa azimuth)
==> || f-104  (measurement-name mlse elevation)
==> || f-105  (units range feet)
==> || f-106  (units bearing degrees)
==> || f-107  (units azimuth degrees)
==> || f-108  (units elevation degrees)
==> || f-109  (units drag feet)
==> || f-110  (units tacr feet)
==> || f-111  (units baro feet)
==> || f-112  (units mlsr feet)
==> || f-113  (units tacb degrees)
==> || f-114  (units mlsa degrees)
==> || f-115  (units mlse degrees)
==> || f-116  (same-area 1 2)
==> || f-117  (same-area 2 1)
==> || f-118  (same-area 3 4)
==> || f-119  (same-area 4 3)
==> || f-120  (same-area 5 6)
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==> || f-122  (same-area 7 8)
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==> || f-124  (same-area 9 10)
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==> || f-142  (same-area 27 28)
==> || f-143  (same-area 28 27)
==> || f-144  (same-area 29 30)
==> || f-145  (same-area 30 29)
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==> f-146   (phase fact-assertion)
==> Activation   0 control-kickoff: f-146
==> f-147   (next-phase fact-assertion monitoring)
==> Activation   1 control-phase fact-assertion monitoring: f-147  f-146
==> f-148   (next-phase monitoring analysis)
==> f-149   (next-phase analysis output)
==> f-150   (next-phase output fact-assertion)
CLIPS> (assert (single step))
==> f-151   (single step)
CLIPS> (run)
FIRE   1 control-kickoff: f-146
FIRE   2 control-change-phases: f-147  f-146
==> f-146   (phase fact-assertion)
==> f-152   (phase monitoring)
==> Activation   2 control-change-phases:   f-148  f-152
FIRE   3 control-change-phases:   f-148  f-152
<== f-152   (phase monitoring)
==> f-153   (phase analysis)
==> Activation   3 control-change-phases:  f-149  f-153
FIRE   4 control-change-phases:   f-149  f-153
<== f-153   (phase analysis)
==> f-154   (phase output)
==> Activation   4 control-change-phases:   f-150  f-154
==> Activation   5 control-end-of-cycle:  f-151  f-154
FIRE   5 control-end-of-cycle:  f-151  f-154
5 rules fired
Run time is 0.7500 seconds
CLIPS> (clear)
Excising rule: control-kickoff
Excising rule: control-change-phases
Excising rule: control-end-of-cycle
Excising rule: control-kickoff-subphase
Excising rule: control-next-subphase
Excising rule: control-last-subphase
CLIPS> (dribble-off)
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APPENDIX

C - Repair test file for test 4.3.1.1 described in section 3.4.1 of this document.

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APPENDIX

D - Interface light rule set modified to support status light checks for test 4.3.2 described in section 3.4.7 of this document.

```
;*********************************************************************

;;; GROUP Output Management

;;;     These groups determine what needs to be displayed and how it is
;;;     to be displayed.

;;; CONTROL FACTS
;;;     (phase output)

;;; CONTAINING GROUP
;;;     Entry

;*********************************************************************
;*********************************************************************

;;; GROUP Event Management

;;;     This group manages the transmission of event notices to the message
;;;     windows.  An event notice is received as a fact with the following
;;;     form:

;;;         (event ?subsystem ?mode ?tag $?text)
;;;     where   ?subsystem = the name of the subsystem generating the event
;;;             ?mode = nominal or off-nominal
;;;             ?tag = alt, mach, or none
;;;             $?text = the text of the message

;;; CONTROL FACTS
;;;     (phase output)

;;; CONTAINING GROUP
;;;     Output Management

;*********************************************************************

;;; FACTS

(defrule logging-off

;;;     IF      . The logging is set to on AND
;;;               The operator entered the logging-off indicator

;;;     THEN    Turn message logging off

;;;     END

    ?x <- (logfile on)
    ?y <- (operator-input log-off)
    =>
    (assert (logfile off))
    (retract ?y)
    (retract ?x))
```

```
(defrule logging-on
  ;;; IF   The logging is set to off AND
  ;;;      The operator entered the logging-on indicator
  ;;; THEN Turn message logging on
  ;;; END

  ?x <- (logfile off)
  ?y <- (operator-input log-on)
  =>
  (assert (logfile on))
  (retract ?y)
  (retract ?x))

(defrule output-print-event
  ;;; IF   An event needs to be printed
  ;;; THEN Print it on the main message window and the appropriate
  ;;;      subsystem window
  ;;; END

  (phase output)
  ?x <- (event ?subsystem ?mode ?tag $?text)
  (logfile ?on_off)
  =>
  (bind ?n 1)
  (bind ?l (length $?text))
  (while (<= ?n ?l)
    (bind ?a (nth ?n $?text))
    (if (numberp ?a)
      then (call (format message "%g" ?a))
      else (call (format message "%s" ?a)))
    (bind ?n (+ ?n 1)))
  (call (format message "\n"))
  (call (message main ?mode event ?tag))
  (call (message ?subsystem ?mode event ?tag))
  (if (eq ?on_off on )
    then (call (log_message ?subsystem ?mode event ?tag)))
  (retract ?x))

;;;********************************************************************
```

```
;;; GROUP Recommendation Management

;;  This group of rules handles the printout of recommendations at regular
;;  intervals. Recommendations are sent to this group from other rules
;;  in the form of a fact:

;;      (recommend ?subsystem ?id ?mode ?tag $?text)

;;  where    ?subsystem = the name of the subsystem generating the event
;;           ?id = name of the recommendation (to distinguish it from other
;;                 recommendations).
;;           ?mode = nominal or off-nominal
;;           ?tag = alt, mach, or none
;;           $?text = the text of the message

;;  The recommendation rules also keep an internal record of active
;;  recommendations using facts of the following form:

;;      (active-message ?subsystem ?id ?a ?b ?time $?text)

;;  where    ?subsystem = same as recommendation subsystem
;;           ?id = same as recommendation id
;;           ?a = message number on main message window
;;           ?b = message number on subsystem message window
;;           ?time = time the recommendation was last checked
;;           $?text = the text of the message

;;  For a recommendation to remain active, the rule that asserts it must
;;  re-assert it on every cycle. If a recommendation is not asserted on
;;  a given cycle, then it is assumed to no longer be active.

;;  CONTROL FACTS
;;      (phase output)

;;  CONTAINING GROUP
;;      Output Management

;;********************************************************************************

(defrule output-print-recommendation
    (phase output)
    ?x <- (recommend ?subsystem ?id ?mode ?tag $?text)
    (not (active-message ?subsystem ?id ? ? ? $?text))
    (current-time ?time)
    (logfile ?on_off)
  =>
    (bind ?n 1)
    (bind ?l (length $?text))
    (while (<= ?n ?l)
        (bind ?s (nth ?n $?text))
        (if (numberp ?s)
            then
                (call (format message "%g" ?s))
            else (call (format message "%s" ?s))))
```

```
(deffacts light-locations

   ; These facts define the locations
   ;   (line and column number) for each
   ;   of the subsystems and LRUs

   (light-location runway pass 1 10)
   (light-location runway bfs 1 15)
   (light-location runway ground 1 20)
   (light-location tacan pass 2 10)
   (light-location tacan bfs 2 15)
   (light-location state pass 3 10)
   (light-location state bfs 3 15)
   (light-location state ground 3 20)
   (light-location three-state 1 6 10)
   (light-location three-state 2 6 15)
   (light-location three-state 3 6 20)
   (light-location pass-imu 1 7 10)
   (light-location pass-imu 2 7 15)
   (light-location pass-imu 3 7 20)
   (light-location bfs-imu 1 8 10)
   (light-location bfs-imu 2 8 15)
   (light-location bfs-imu 3 8 20)
   (light-location drag 0 9 10)
   (light-location tacr 1 10 10)
   (light-location tacr 2 10 15)
   (light-location tacr 3 10 20)
   (light-location tacb 1 11 10)
   (light-location tacb 2 11 15)
   (light-location tacb 3 11 20)
   (light-location tacb cone 11 0)
   (light-location baro 0 12 10)
   (light-location msr 1 13 10)
   (light-location msr 2 13 15)
   (light-location msr 3 13 20)
   (light-location msa 1 14 10)
   (light-location msa 2 14 15)
   (light-location msa 3 14 20)
   (light-location mse 1 15 10)
   (light-location mse 2 15 15)
   (light-location mse 3 15 20)
   (light-location tlm 0 16 10)

   (status-light runway pass no-go)
   (status-light runway bfs no-go)
   (status-light runway ground no-go)
   (status-light tacan pass no-go)
   (status-light tacan bfs no-go)
   (status-light state pass no-go)
   (status-light state bfs no-go)
   (status-light state ground no-go)
   (status-light three-state 1 no-go)
   (status-light three-state 2 no-go)
   (status-light three-state 3 no-go)
   (status-light pass-imu 1 no-go)
   (status-light pass-imu 2 no-go)
   (status-light pass-imu 3 no-go)
   (status-light bfs-imu 1 no-go)
   (status-light bfs-imu 2 no-go)
```

```
(defrule output-update-status-light
  (phase output)
  ?x <- (status-light ?id ?sub-id ?value)
  (display-value ?value ?word ?mode)
  (light-location ?id ?sub-id ?row ?column)
  (logfile ?on_off)
  =>
  (retract ?x)
  (if (eq ?on_off on )
    then
      (call (log_status ?id ?word ?mode )))
  (call (status-light ?row ?column ?mode ?word)))
```