Estimating End-of-Life Failure Probability of 2L53

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SPPA, BCTC

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This report is to estimate the end-of-life failure probability of 2L53 using the Weibull distribution model.

1. Weibull distribution model

The Weibull distribution has been widely recognized in the power industry to model the aging period of power equipment in the life basin curve. The end-of-life failure probability of 2L53 was estimated using the Weibull model in this report.

2. Data

In order to use the Weibull distribution to model end-of-life failure probability, the following three input data are needed: mean life, standard deviation and age.

(1) The four similar cables of 2L39, 2L40, 2L46 and 2L55 were replaced in the past. The in-service years and replaced years of the four cables are shown in Table 1 and were used to calculate the mean life.
(2) 2L53 may or may not still survive for other 5 to 8 years. Therefore the standard deviation of mean life was assumed to be 5 to 8 years in the analysis.
(3) 2L53 was installed in 1960. In other word, its age is 45 years in 2005.

Table 1 Data of four similar cables

| Cable	In-service year	Replaced year	Life
2L39	1957	2001	44
2L40	1957	2003	46
2L46	1957	2003	46
2L55	1958	2005	47

3. Computing tool

The computing program called SPARE was used to perform the evaluation. SPARE has several functions, including estimation of failure probability and availability of individual equipment due to both end-of-life and repairable failure modes, evaluation of failure probability for an equipment group and spare analysis. The first function was utilized in the report.

4. Results

The end-of-life failure probabilities of 2L53 from 2005 to 2014 were given in Table 2 and shown in the following figure. It can be seen that the end-of-life failure probability of 2L53 will dramatically increase as time advances. In order to cover the uncertainty due to input data, the upper and lower estimates are provided.

Table 2 End-of-life failure probability of 2L53

year	failure probability due to end-of-life	
	lower estimate	upper estimate
2005	0.09462	0.15572
2006	0.10644	0.19115
2007	0.11933	0.2325
2008	0.13336	0.28003
2009	0.14855	0.33377
2010	0.16495	0.3934
2011	0.18259	0.45817
2012	0.2015	0.52683
2013	0.22168	0.59761
2014	0.24313	0.66826
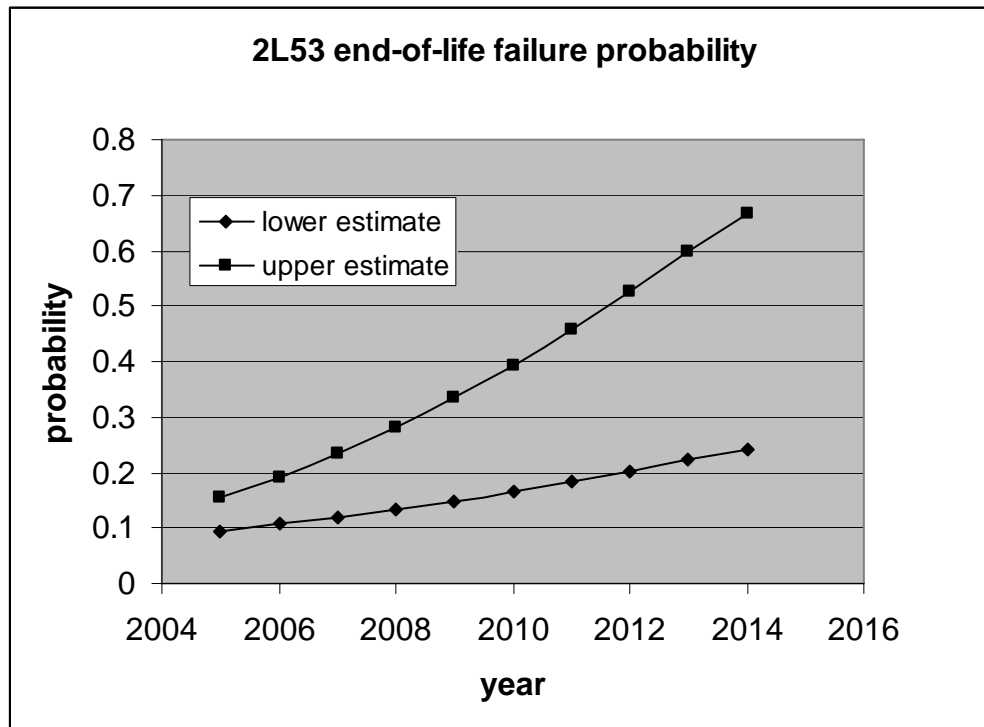
5. Notes

It should be appreciated that the results in the report are based on probability calculations. Like any other probability analysis, there is some uncertainty around the results due to input data. However, the results provide the quantified information about the end-of-life failure probability of 2L53 in the future. Note that the future failure probability due to end-of-life generally cannot be estimated using historical repairable failure records.

6. Outputs from running the SPARE program

```
Wed Jun 29 13:08:13 2005


 System Input Summary:


 Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)


     RELIABILITY MODEL: NON-REPAIRABLE ONLY
     (Only aging failures for non-repairable)
     (Posteriori Weibull distribution for aging failures)

     Analysis starting year         :    2005
     Subsequent operating years     :     1.0
     Component mean life            :    45.0
     Mean life standard deviation   :     5.0
     Number of components           :      1


                   Component Data
 ------------------------------------------------------------
                         Fail  Repair  Chance   Adjustment
 Component In-serv Oper  Freg.  Time  Fail rate Coefficient
    ID      Year   Year (f/yr) (hr/f)  (f/yr)
 ------------------------------------------------------------
 2L53      1960    45                            1.000
 ------------------------------------------------------------
  * "Fail Freq." and "Repair Time" are failure frequency
    and repair time for repairable failures.
  * "Chance Fail rate" is chance failure rate for
    non-repairable failures.
  *  Adjustment coefficient is a percentage factor for
    probability to failure and unavailability of aging failure
 ------------------------------------------------------------
        _____



 alfa=    47.0983934327366
 beta=    11.3899999904633


 Output:
```

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```
                  Component Availability/Unavailability
--------------------------------------------------------------------------------
 Component     Repairable            Non-Repairable          Total
    ID      Avail.  Unavail  Availability  Unavailability  Avail.  Unavail
                              Chance  Aging   Chance  Aging
--------------------------------------------------------------------------------
 2L53                          0.92290         0.07710 0.92290 0.07710
--------------------------------------------------------------------------------
  * "Availability" is average probability being found available
    during a given period (i.e., "subsequent years" in input data).
  * "Unavailability" is average probability being found unavailable
    during a given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------------------------


            Component Survival/Failure Probability
-----------------------------------------------------------------
 Component    Chance           Aging            Toatal
    ID     Surv.   Prob.    Surv.   Prob.    Surv.    Pro.
           Prob.   to Fail. Prob.   to Fail. Prob.    to Fail.
-----------------------------------------------------------------
 2L53                        0.84428 0.15572  0.84428 0.15572
-----------------------------------------------------------------
  * "Surv. Prob." is probability that a component still has
    survived by the end of the given period (never failed).
  * "Prob. to Fail." is probability that a component has
    failed at some point within the given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
-----------------------------------------------------------------




 System Input Summary:


 Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)


     RELIABILITY MODEL: NON-REPAIRABLE ONLY
     (Only aging failures for non-repairable)
     (Posteriori Weibull distribution for aging failures)

     Analysis starting year        :   2006
     Subsequent operating years    :    1.0
     Component mean life           :   45.0
     Mean life standard deviation  :    5.0
     Number of components          :      1


                  Component Data
-----------------------------------------------------------------
                       Fail  Repair  Chance   Adjustment
 Component In-serv Oper  Freg.  Time  Fail rate Coefficient
    ID      Year  Year  (f/yr) (hr/f)  (f/yr)
```

```
-------------------------------------------------------------
2L53       1960    46                              1.000
-------------------------------------------------------------
  * "Fail Freq." and "Repair Time" are failure frequency
    and repair time for repairable failures.
  * "Chance Fail rate" is chance failure rate for
    non-repairable failures.
  *  Adjustment coefficient is a percentage factor for
     probability to failure and unavailability of aging failure
  -------------------------------------------------------------

     _____


alfa=     47.0983934327366
beta=     11.3899999904633


Output:


              Component Availability/Unavailability
--------------------------------------------------------------------------------
Component      Repairable            Non-Repairable           Total
   ID       Avail.  Unavail  Availability  Unavailability  Avail.  Unavail
                             Chance  Aging  Chance  Aging
--------------------------------------------------------------------------------
2L53                          0.90460          0.09540 0.90460 0.09540
--------------------------------------------------------------------------------
  * "Availability" is average probability being found available
    during a given period (i.e., "subsequent years" in input data).
  * "Unavailability" is average probability being found unavailable
    during a given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------------------------


              Component Survival/Failure Probability
--------------------------------------------------------------
 Component      Chance          Aging          Toatal
   ID       Surv.    Prob.   Surv.    Prob.   Surv.    Pro.
           Prob.   to Fail.  Prob.   to Fail. Prob.   to Fail.
--------------------------------------------------------------
 2L53                         0.80885 0.19115  0.80885 0.19115
--------------------------------------------------------------
  * "Surv. Prob." is probability that a component still has
    survived by the end of the given period (never failed).
  * "Prob. to Fail." is probability that a component has
    failed at some point within the given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------


System Input Summary:


Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)
```

```
RELIABILITY MODEL: NON-REPAIRABLE ONLY
(Only aging failures for non-repairable)
(Posteriori Weibull distribution for aging failures)

Analysis starting year          :   2007
Subsequent operating years      :    1.0
Component mean life             :   45.0
Mean life standard deviation    :    5.0
Number of components            :      1


                    Component Data
-----------------------------------------------------------------
                         Fail  Repair  Chance    Adjustment
  Component In-serv Oper Freq.  Time  Fail rate Coefficient
    ID       Year   Year (f/yr) (hr/f)  (f/yr)
-----------------------------------------------------------------
2L53       1960    47                             1.000
-----------------------------------------------------------------
 * "Fail Freq." and "Repair Time" are failure frequency
   and repair time for repairable failures.
 * "Chance Fail rate" is chance failure rate for
   non-repairable failures.
 * Adjustment coefficient is a percentage factor for
   probability to failure and unavailability of aging failure
-----------------------------------------------------------------
       _____


alfa=     47.0983934327366
beta=     11.3899999904633


Output:


              Component Availability/Unavailability
--------------------------------------------------------------------------------
Component      Repairable           Non-Repairable            Total
   ID      Avail. Unavail  Availability  Unavailability  Avail.  Unavail
                          Chance  Aging  Chance  Aging
--------------------------------------------------------------------------------
2L53                              0.88288        0.11712 0.88288 0.11712
--------------------------------------------------------------------------------
 * "Availability" is average probability being found available
   during a given period (i.e., "subsequent years" in input data).
 * "Unavailability" is average probability being found unavailable
   during a given period.
 * "Chance" refers to non-repairable chance failure.
 * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------------------------


         Component Survival/Failure Probability
-----------------------------------------------------------------
 Component    Chance        Aging          Toatal
   ID      Surv.  Prob.  Surv.  Prob.  Surv.    Pro.
          Prob.  to Fail. Prob. to Fail. Prob.  to Fail.
-----------------------------------------------------------------
2L53                     0.76750 0.23250 0.76750 0.23250
-----------------------------------------------------------------
 * "Surv. Prob." is probability that a component still has
```

survived by the end of the given period (never failed).
* "Prob. to Fail." is probability that a component has
  failed at some point within the given period.
* "Chance" refers to non-repairable chance failure.
* "Aging" refers to non-repairable aging failure.

System Input Summary:

Your input file for this run is: 2l53-sd5.dat

    Probability Analysis Only
    (No Probabilistic Cost Analysis)

    RELIABILITY MODEL: NON-REPAIRABLE ONLY
    (Only aging failures for non-repairable)
    (Posteriori Weibull distribution for aging failures)

    Analysis starting year   :   2008
    Subsequent operating years   :   1.0
    Component mean life   :   45.0
    Mean life standard deviation   :   5.0
    Number of components   :   1

                    Component Data

                        Fail Repair Chance   Adjustment
 Component In-serv Oper Freq. Time Fail rate Coefficient
    ID   Year Year (f/yr) (hr/f) (f/yr)

2L53   1960   48   1.000
----
 * "Fail Freq." and "Repair Time" are failure frequency
   and repair time for repairable failures.
 * "Chance Fail rate" is chance failure rate for
   non-repairable failures.
 * Adjustment coefficient is a percentage factor for
    probability to failure and unavailability of aging failure
----
            _____

alfa=   47.0983934327366
beta=   11.3899999904633

Output:

              Component Availability/Unavailability

Component   Repairable   Non-Repairable   Total
   ID   Avail. Unavail Availability Unavailability Avail. Unavail
                             Chance Aging   Chance Aging

2L53   0.85736   0.14264 0.85736 0.14264

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```
     * "Availability" is average probability being found available
       during a given period (i.e., "subsequent years" in input data).
     * "Unavailability" is average probability being found unavailable
       during a given period.
     * "Chance" refers to non-repairable chance failure.
     * "Aging" refers to non-repairable aging failure.
------------------------------------------------------------------------------


             Component Survival/Failure Probability
     ----------------------------------------------------------------
      Component     Chance           Aging           Toatal
         ID      Surv.   Prob.    Surv.   Prob.    Surv.    Pro.
                 Prob.  to Fail.  Prob.  to Fail.  Prob.   to Fail.
     ----------------------------------------------------------------
      2L53                        0.71997 0.28003  0.71997 0.28003
     ----------------------------------------------------------------
       * "Surv. Prob." is probability that a component still has
         survived by the end of the given period (never failed).
       * "Prob. to Fail." is probability that a component has
         failed at some point within the given period.
       * "Chance" refers to non-repairable chance failure.
       * "Aging" refers to non-repairable aging failure.
     ----------------------------------------------------------------




      System Input Summary:


      Your input file for this run is: 2l53-sd5.dat


          Probability Analysis Only
          (No Probabilistic Cost Analysis)


          RELIABILITY MODEL: NON-REPAIRABLE ONLY
          (Only aging failures for non-repairable)
          (Posteriori Weibull distribution for aging failures)

          Analysis starting year          :    2009
          Subsequent operating years      :     1.0
          Component mean life             :    45.0
          Mean life standard deviation    :     5.0
          Number of components            :       1


                      Component Data
     ----------------------------------------------------------------
                             Fail   Repair  Chance    Adjustment
      Component In-serv Oper  Freq.  Time  Fail rate Coefficient
         ID       Year  Year  (f/yr) (hr/f) (f/yr)
     ----------------------------------------------------------------
      2L53       1960   49                              1.000
     ----------------------------------------------------------------
       * "Fail Freq." and "Repair Time" are failure frequency
         and repair time for repairable failures.
       * "Chance Fail rate" is chance failure rate for
         non-repairable failures.
       *  Adjustment coefficient is a percentage factor for
         probability to failure and unavailability of aging failure
     ----------------------------------------------------------------
```

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                    _____


  alfa=       47.0983934327366
  beta=       11.3899999904633


  Output:


                    Component Availability/Unavailability
  ------------------------------------------------------------------------------
  Component     Repairable              Non-Repairable           Total
     ID      Avail.  Unavail  Availability  Unavailability Avail.  Unavail
                              Chance  Aging  Chance  Aging
  ------------------------------------------------------------------------------
  2L53                            0.82774          0.17226 0.82774 0.17226
  ------------------------------------------------------------------------------
   * "Availability" is average probability being found available
     during a given period (i.e., "subsequent years" in input data).
   * "Unavailability" is average probability being found unavailable
     during a given period.
   * "Chance" refers to non-repairable chance failure.
   * "Aging" refers to non-repairable aging failure.
  ------------------------------------------------------------------------------


                    Component Survival/Failure Probability
  ----------------------------------------------------------------
   Component     Chance           Aging            Toatal
     ID      Surv.    Prob.   Surv.    Prob.   Surv.     Pro.
             Prob.   to Fail. Prob.   to Fail. Prob.    to Fail.
  ----------------------------------------------------------------
  2L53                         0.66623 0.33377  0.66623 0.33377
  ----------------------------------------------------------------
   * "Surv. Prob." is probability that a component still has
     survived by the end of the given period (never failed).
   * "Prob. to Fail." is probability that a component has
     failed at some point within the given period.
   * "Chance" refers to non-repairable chance failure.
   * "Aging" refers to non-repairable aging failure.
  ----------------------------------------------------------------


  System Input Summary:


  Your input file for this run is: 2l53-sd5.dat


      Probability Analysis Only
      (No Probabilistic Cost Analysis)


      RELIABILITY MODEL: NON-REPAIRABLE ONLY
      (Only aging failures for non-repairable)
      (Posteriori Weibull distribution for aging failures)

      Analysis starting year          :    2010
      Subsequent operating years      :     1.0
      Component mean life             :    45.0
      Mean life standard deviation    :     5.0
```

```
     Number of components             :        1


                    Component Data
     ---------------------------------------------------------
                          Fail  Repair  Chance  Adjustment
     Component In-serv Oper Freg.  Time  Fail rate Coefficient
        ID       Year  Year (f/yr) (hr/f) (f/yr)
     ---------------------------------------------------------
     2L53      1960    50                         1.000
     ---------------------------------------------------------
      * "Fail Freq." and "Repair Time" are failure frequency
        and repair time for repairable failures.
      * "Chance Fail rate" is chance failure rate for
        non-repairable failures.
      * Adjustment coefficient is a percentage factor for
        probability to failure and unavailability of aging failure
     ---------------------------------------------------------

        _____


     alfa=     47.0983934327366
     beta=     11.3899999904633


     Output:


             Component Availability/Unavailability
     ------------------------------------------------------------------------
     Component      Repairable            Non-Repairable          Total
        ID      Avail. Unavail Availability  Unavailability Avail.  Unavail
                             Chance  Aging   Chance  Aging
     ------------------------------------------------------------------------
      2L53                          0.79381         0.20619 0.79381 0.20619
     ------------------------------------------------------------------------
      * "Availability" is average probability being found available
        during a given period (i.e., "subsequent years" in input data).
      * "Unavailability" is average probability being found unavailable
        during a given period.
      * "Chance" refers to non-repairable chance failure.
      * "Aging" refers to non-repairable aging failure.
     ------------------------------------------------------------------------


          Component Survival/Failure Probability
     -----------------------------------------------------------------
      Component    Chance          Aging           Toatal
        ID      Surv.   Prob.   Surv.   Prob.   Surv.   Pro.
              Prob.  to Fail. Prob.  to Fail. Prob.   to Fail.
     -----------------------------------------------------------------
      2L53                    0.60660 0.39340  0.60660 0.39340
     -----------------------------------------------------------------
      * "Surv. Prob." is probability that a component still has
        survived by the end of the given period (never failed).
      * "Prob. to Fail." is probability that a component has
        failed at some point within the given period.
      * "Chance" refers to non-repairable chance failure.
      * "Aging" refers to non-repairable aging failure.
     -----------------------------------------------------------------
```

```
System Input Summary:


Your input file for this run is: 2l53-sd5.dat


    Probability Analysis Only
    (No Probabilistic Cost Analysis)


    RELIABILITY MODEL: NON-REPAIRABLE ONLY
    (Only aging failures for non-repairable)
    (Posteriori Weibull distribution for aging failures)

    Analysis starting year        :    2011
    Subsequent operating years    :    1.0
    Component mean life           :   45.0
    Mean life standard deviation  :    5.0
    Number of components          :      1


                    Component Data
    -----------------------------------------------------------
                          Fail  Repair  Chance   Adjustment
    Component In-serv Oper  Freg.  Time  Fail rate Coefficient
       ID      Year  Year  (f/yr) (hr/f)  (f/yr)
    -----------------------------------------------------------
    2L53     1960   51                            1.000
    -----------------------------------------------------------
     * "Fail Freq." and "Repair Time" are failure frequency
       and repair time for repairable failures.
     * "Chance Fail rate" is chance failure rate for
       non-repairable failures.
     * Adjustment coefficient is a percentage factor for
       probability to failure and unavailability of aging failure
    -----------------------------------------------------------
            _____


    alfa=     47.0983934327366
    beta=     11.3899999904633


 Output:


              Component Availability/Unavailability
    ------------------------------------------------------------------------------
    Component     Repairable              Non-Repairable            Total
       ID     Avail. Unavail Availability  Unavailability Avail.  Unavail
                            Chance  Aging  Chance  Aging
    ------------------------------------------------------------------------------
    2L53                           0.75550          0.24450 0.75550 0.24450
    ------------------------------------------------------------------------------
     * "Availability" is average probability being found available
       during a given period (i.e., "subsequent years" in input data).
     * "Unavailability" is average probability being found unavailable
       during a given period.
     * "Chance" refers to non-repairable chance failure.
     * "Aging" refers to non-repairable aging failure.
    ------------------------------------------------------------------------------


          Component Survival/Failure Probability
```

```
----------------------------------------------------------------
 Component     Chance          Aging          Toatal
   ID      Surv.   Prob.   Surv.   Prob.   Surv.   Pro.
           Prob.  to Fail. Prob.  to Fail. Prob.   to Fail.
----------------------------------------------------------------
 2L53                       0.54183 0.45817  0.54183 0.45817
----------------------------------------------------------------
  * "Surv. Prob." is probability that a component still has
    survived by the end of the given period (never failed).
  * "Prob. to Fail." is probability that a component has
    failed at some point within the given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
----------------------------------------------------------------




 System Input Summary:


 Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)


     RELIABILITY MODEL: NON-REPAIRABLE ONLY
     (Only aging failures for non-repairable)
     (Posteriori Weibull distribution for aging failures)

     Analysis starting year          :   2012
     Subsequent operating years      :    1.0
     Component mean life             :   45.0
     Mean life standard deviation    :    5.0
     Number of components            :      1


                   Component Data
----------------------------------------------------------------
                          Fail  Repair  Chance   Adjustment
 Component In-serv Oper   Freg.  Time  Fail rate Coefficient
    ID      Year   Year  (f/yr) (hr/f)  (f/yr)
----------------------------------------------------------------
 2L53      1960    52                               1.000
----------------------------------------------------------------
  * "Fail Freq." and "Repair Time" are failure frequency
    and repair time for repairable failures.
  * "Chance Fail rate" is chance failure rate for
    non-repairable failures.
  * Adjustment coefficient is a percentage factor for
    probability to failure and unavailability of aging failure
----------------------------------------------------------------
           _____


 alfa=     47.0983934327366
 beta=     11.3899999904633


 Output:
```

```
                Component Availability/Unavailability
--------------------------------------------------------------------------------
 Component    Repairable          Non-Repairable           Total
    ID      Avail. Unavail Availability  Unavailability Avail. Unavail
                            Chance Aging  Chance Aging
--------------------------------------------------------------------------------
 2L53                        0.71292       0.28708 0.71292 0.28708
--------------------------------------------------------------------------------
   * "Availability" is average probability being found available
     during a given period (i.e., "subsequent years" in input data).
   * "Unavailability" is average probability being found unavailable
     during a given period.
   * "Chance" refers to non-repairable chance failure.
   * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------------------------


           Component Survival/Failure Probability
-----------------------------------------------------------------
 Component    Chance          Aging          Toatal
    ID      Surv.   Prob.   Surv.   Prob.   Surv.    Pro.
            Prob.  to Fail. Prob.  to Fail. Prob.   to Fail.
-----------------------------------------------------------------
 2L53                        0.47317 0.52683  0.47317 0.52683
-----------------------------------------------------------------
   * "Surv. Prob." is probability that a component still has
     survived by the end of the given period (never failed).
   * "Prob. to Fail." is probability that a component has
     failed at some point within the given period.
   * "Chance" refers to non-repairable chance failure.
   * "Aging" refers to non-repairable aging failure.
-----------------------------------------------------------------




 System Input Summary:


 Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)


     RELIABILITY MODEL: NON-REPAIRABLE ONLY
     (Only aging failures for non-repairable)
     (Posteriori Weibull distribution for aging failures)

     Analysis starting year        :   2013
     Subsequent operating years    :    1.0
     Component mean life           :   45.0
     Mean life standard deviation  :    5.0
     Number of components          :      1


                Component Data
-------------------------------------------------------------
                       Fail  Repair  Chance   Adjustment
 Component In-serv Oper  Freg.  Time  Fail rate Coefficient
    ID      Year  Year  (f/yr) (hr/f) (f/yr)
-------------------------------------------------------------
 2L53       1960   53                            1.000
```

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```
      --------------------------------------------------------------
      * "Fail Freq." and "Repair Time" are failure frequency
        and repair time for repairable failures.
      * "Chance Fail rate" is chance failure rate for
        non-repairable failures.
      * Adjustment coefficient is a percentage factor for
        probability to failure and unavailability of aging failure
      --------------------------------------------------------------
            _____
```

```
      alfa=     47.0983934327366
      beta=     11.3899999904633
```

Output:

```
                  Component Availability/Unavailability
   --------------------------------------------------------------------------------
   Component     Repairable            Non-Repairable          Total
      ID      Avail. Unavail  Availability   Unavailability  Avail. Unavail
                              Chance  Aging  Chance  Aging
   --------------------------------------------------------------------------------
   2L53                       0.66642         0.33358 0.66642 0.33358
   --------------------------------------------------------------------------------
    * "Availability" is average probability being found available
      during a given period (i.e., "subsequent years" in input data).
    * "Unavailability" is average probability being found unavailable
      during a given period.
    * "Chance" refers to non-repairable chance failure.
    * "Aging" refers to non-repairable aging failure.
   --------------------------------------------------------------------------------
```

```
                  Component Survival/Failure Probability
   -------------------------------------------------------------------
    Component     Chance           Aging           Toatal
       ID      Surv.    Prob.    Surv.    Prob.   Surv.    Pro.
               Prob.   to Fail.  Prob.   to Fail. Prob.   to Fail.
   -------------------------------------------------------------------
    2L53                         0.40239 0.59761  0.40239 0.59761
   -------------------------------------------------------------------
    * "Surv. Prob." is probability that a component still has
      survived by the end of the given period (never failed).
    * "Prob. to Fail." is probability that a component has
      failed at some point within the given period.
    * "Chance" refers to non-repairable chance failure.
    * "Aging" refers to non-repairable aging failure.
   -------------------------------------------------------------------
```

```
   System Input Summary:
```

```
   Your input file for this run is: 2l53-sd5.dat
```

```
       Probability Analysis Only
       (No Probabilistic Cost Analysis)
```

```
RELIABILITY MODEL: NON-REPAIRABLE ONLY
(Only aging failures for non-repairable)
(Posteriori Weibull distribution for aging failures)

Analysis starting year          :   2014
Subsequent operating years      :    1.0
Component mean life             :   45.0
Mean life standard deviation    :    5.0
Number of components            :      1
```

                          Component Data

                          Fail   Repair Chance   Adjustment
 Component In-serv Oper   Freg.   Time Fail rate Coefficient
    ID   Year Year (f/yr) (hr/f) (f/yr)

2L53   1960   54   1.000
----
 * "Fail Freq." and "Repair Time" are failure frequency
   and repair time for repairable failures.
 * "Chance Fail rate" is chance failure rate for
   non-repairable failures.
 * Adjustment coefficient is a percentage factor for
   probability to failure and unavailability of aging failure
----
         _____


```
alfa=     47.0983934327366
beta=     11.3899999904633
```

Output:

                 Component Availability/Unavailability

 Component   Repairable   Non-Repairable   Total
    ID   Avail. Unavail Availability Unavailability Avail. Unavail
                             Chance Aging Chance Aging

 2L53   0.61661   0.38339 0.61661 0.38339
----
 * "Availability" is average probability being found available
   during a given period (i.e., "subsequent years" in input data).
 * "Unavailability" is average probability being found unavailable
   during a given period.
 * "Chance" refers to non-repairable chance failure.
 * "Aging" refers to non-repairable aging failure.

            Component Survival/Failure Probability

 Component   Chance   Aging   Toatal
    ID   Surv.   Prob.   Surv.   Prob.   Surv.   Pro.
           Prob. to Fail. Prob.   to Fail. Prob.   to Fail.

 2L53   0.33174 0.66826 0.33174 0.66826
----
 * "Surv. Prob." is probability that a component still has
   survived by the end of the given period (never failed).
 * "Prob. to Fail." is probability that a component has

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```
    failed at some point within the given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
-----------------------------------------------------------------




 System Input Summary:


 Your input file for this run is: 2l53-sd5.dat


     Probability Analysis Only
     (No Probabilistic Cost Analysis)


     RELIABILITY MODEL: NON-REPAIRABLE ONLY
     (Only aging failures for non-repairable)
     (Posteriori Weibull distribution for aging failures)

     Analysis starting year          :    2015
     Subsequent operating years      :     1.0
     Component mean life             :    45.0
     Mean life standard deviation    :     5.0
     Number of components            :       1


                      Component Data
     -----------------------------------------------------------
                            Fail   Repair  Chance   Adjustment
     Component In-serv Oper  Freq.   Time  Fail rate Coefficient
        ID       Year  Year (f/yr)  (hr/f)  (f/yr)
     -----------------------------------------------------------
     2L53      1960    55                              1.000
     -----------------------------------------------------------
      * "Fail Freq." and "Repair Time" are failure frequency
        and repair time for repairable failures.
      * "Chance Fail rate" is chance failure rate for
        non-repairable failures.
      *  Adjustment coefficient is a percentage factor for
         probability to failure and unavailability of aging failure
     -----------------------------------------------------------
             _____


 alfa=     47.0983934327366
 beta=     11.3899999904633


 Output:


               Component Availability/Unavailability
 -------------------------------------------------------------------------------
 Component       Repairable           Non-Repairable            Total
    ID        Avail. Unavail Availability  Unavailability Avail.  Unavail
                              Chance  Aging   Chance  Aging
 -------------------------------------------------------------------------------
 2L53                         0.56436         0.43564 0.56436 0.43564
 -------------------------------------------------------------------------------
   * "Availability" is average probability being found available
     during a given period (i.e., "subsequent years" in input data).
```

```
  * "Unavailability" is average probability being found unavailable
    during a given period.
  * "Chance" refers to non-repairable chance failure.
  * "Aging" refers to non-repairable aging failure.
--------------------------------------------------------------------------------


            Component Survival/Failure Probability
      ----------------------------------------------------------------
       Component    Chance            Aging           Toatal
         ID      Surv.   Prob.    Surv.    Prob.   Surv.    Pro.
                 Prob.   to Fail. Prob.    to Fail. Prob.   to Fail.
      ----------------------------------------------------------------
       2L53                        0.26374 0.73626  0.26374 0.73626
      ----------------------------------------------------------------
        * "Surv. Prob." is probability that a component still has
          survived by the end of the given period (never failed).
        * "Prob. to Fail." is probability that a component has
          failed at some point within the given period.
        * "Chance" refers to non-repairable chance failure.
        * "Aging" refers to non-repairable aging failure.
      ----------------------------------------------------------------
```