Abnormal Signal Analysis for a Change of the R-C Passive Elements in a Equivalent Circuit Modeling under a High Temperature Accident Condition

Kil-Mo Koo, a Yong-Mann Song, b Kwang-Il Ahan, b Jea-Joo Ha, b

a Department of Thermal-Hydrauric Safety Research Team, KAERI, 150 Dukjin-dong, Yuseong, Daejeon, 305-353, Korea, : kmkoo@kaeri.re.kr

b Development of Next Generation PSA Technology and Integrated Risk/Performance Analysis Technology , KAERI, 150 Dukjin-dong, Yuseong, Daejeon, 305-353, Korea

1. Introduction

An electrical signal should be checked to see whether it lies within its expected electrical range when there is a doubtful condition. The normal signal level for pressure, flow, level and resistance temperature detector sensors is 4~20mA for most instruments as an industrial process control standard. In the case of an abnormal signal level from an instrument under a severe accident condition, it is necessary to obtain a more accurate signal validation to operate a system in a control room in NPPs.[1-2] Diagnostics and analysis for some abnormal signals have been performed through an important equivalent circuits modeling for passive elements under severe accident conditions[3-5]. Unlike the design basis accidents, there are some inherent uncertainties for the instrumentation capabilities under severe accident conditions. In this paper, to implement a diagnostic analysis for an equivalent circuits modeling, a kind of linked LabVIEW program for each PSpice & MULTI-Sim code is introduced as a one body order system, which can obtain some abnormal signal patterns by a special function such as an advanced simulation tool for each PSpice & Multi-SIM code as a means of a function for a PC based ASSA (abnormal signal simulation analyzer) module.

2. ASSA Design

In this section, some of when an instrument which is providing information for managing a severe accident is apparently malfunctioning, a series of steps can be taken which include a direct diagnosis of the instrument and an indirect method for determining the value of a parameter. These methods are identified by eleven stepped processes and five of these steps are called operational aids[2]. They are combinations of diagnostic actions and other means of a measurement system. They can be applied when instrument readouts are suspensive or faulty. The five types of aids are a diverse indication, parameter inference, portable instrument, circuit diagnosis, and a portable circuit readout

2.1 Design of a Simulator

It has three main functions which are a signal processing tool, an accident management tool, and an additional guide for an instrument evaluation as well as an instrument performance diagnosis. The signal processing tools have the position information obtained from 5 areas in the containment building, which includes the information needs of the instruments as well as the status parameters from an accident's class. For the next step in the signal processing tools, we need a decision making step from some signals which means three kinds of signal patterns, of which the first one is normal condition signals, the second one is abnormal signals, and the third one is out of control signals. In the case of abnormal signals, they have to be processed in five steps and finally they can be shown on a CRT screen with enhanced signals.

2.2 Main function of the ASSA

The main function of each PSpice & Multi-SIM engine code is to design an equivalent circuit to simulate the instruments affected by a temperature condition. It is possible to obtain a transient response for the R-L-C circuit elements as an automatic run menu function according to a one step order system logic. This output data could be used to estimate a transients changing value for an abnormal output signal by comparing it with a reference input signal. The estimation procedure for an alternating transient value of an output signal is as follows.

‣ The first estimation is the transient characteristic analysis of the output signal according to an R-L-C elements alternating range for an equivalent circuit.

‣ The second estimation is the temperature alternating range according to a transient characteristic analysis of an output signal.

‣ The third estimation is the diagnostic characteristic of the R-L-C elements for an equivalent circuit according to the alternating temperature range.

Another important function of the module is also possible which is to connect it with a PC and an instrument using an I/O interface of the LabVIEW code. For the first time, during an operating procedure, the establishment of a simulation circuit modeling by the PSpice code is attempted, where the PSpice simulation output file is used as a text file; *.cir, *.sim, *.net file. Next step needs the information on the circuit elements from the *.net file, and then the *.net file can be controlled by an element in the circuit, by using the Labview *.net file condition, and then we take the csd file out of the *.net file in the Labview, and execute the ***System Exec.vi*** file of the PSpice condition. For the last step we extract the output results from the csd file, and then the file can be used to display as some of the abnormal out put signals. Finally, these signals could be processed by an analyzing tool.

3. Analysis for PSpice Data

3.1 Shaping Amplifier Model

As the first data base for the PSpice code simulation, the elements values for the R2, C1 passive elements are changed to obtain the output analysis data.

- Simulation for changing the elements value of R2 :

In the case of the R2 simulation by using the PSpice code, it can be seen that the resistor value changes at high voltage levels which means good linearity (sensitivity) information over 1k to 50k. Figure 1 and table 1 show the output data for the pulse parameter according to a change of the resistance of R2

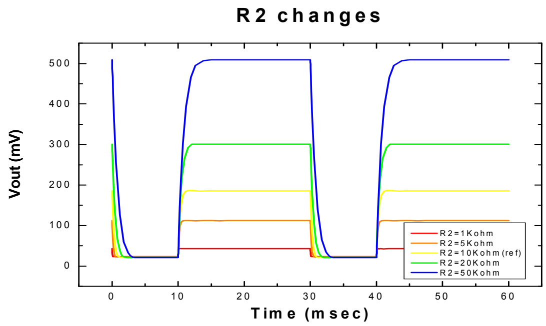

Fig. 1 Output data of the pulse parameter according to a change of the resistance of R2

R (ohm)	Voltage Level (V)	Falling/rising Time (Sec)	BandWidth (Sec)	Pulse Peak Voltage(V)
1K	0.01949	0/0	0.019986	0.04288
5K	0.08975	0.000338/ 0.000265	0.019730	0.11210
10K	0.16379	0.0004542/ 0.0006754	0.019330	0.18560
20K	0.27974	0.0012228/ 0.0009042	0.019088	0.30110
50K	0.48821	0.0016333/ 0.00183546	0.018149	0.50920

- Simulation for changing the elements of value C1 :

In the case of the C1 simulation by using the PSpice code simulation, pulse patterns which have a good linearity characteristic from a changing capacitor value over the basic value 1uF to 100uF by a switch on/off operation could be obtained. In general, there are four types of parameters for the rising time, falling time, band width, and voltage level in the pulse patterns. Figure 2 and table 2 show the output data for the pulse parameter according to a change of the capacitance of C1.

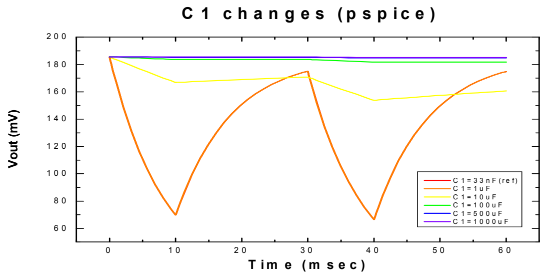

Fig. 2 Output data of the pulse parameter according to a change of the capacitance of C1

Table 2
Output data of the pulse parameter according to a change of the capacitance of C1

Capacitance (F)	Voltage Level (V)	Falling/rising Time (Sec)	BandWidth (Sec)	Pulse Peak Voltage(V)
33nF	0.1024	0.0060/0.01451	0.0095	0.1751
1uF	0.1082	0.0079/0.0139	0.0062	0.1751
10uF	0.0170	0.0084/0.0156	0.0044	0.1708
100uF	0.0002	-	-	-
500uF	0.0004	-	-	-
1000uF	0.0002	-	-	-

3. Conclusion

In this paper, a new simulator by using an analysis of an important circuits modeling under severe accident conditions has been designed. This method affords an easy change of the element RC value. As a result, we could established and display the changing signal patterns from the ASSA system. Thus it is possible to change the output signal by changing the element RC value.

REFERENCES

[1] A. J. Horn, R. W. James, D. E. True, "Assessment of Existing Plant Instrumentation for Severe Accident Management" EPRI TR-103412. [report], (1993).
[2] C. A. Negin, et al., "Instrument Performance under Severe Accident Conditions" TR-102371, (Final 1993)
[3] K. M. Koo, S. B. Kim, H.D. Kim, H. Y. Kang, and H. Y. Kang, "Design for a New Signal Analyzer through a Circuit Modeling Simulation as a One Body System for SAC's", Proceedings of ICAPP'06, Paper No. 6193, pp. 1023-1032, (Jun. 2006)
[4] K. M. Koo, et, al., "Assessment of Existing Ul-Jin 3~4 Plants Instrumentation for Severe Accident Management" Abstract of Proceedings of KSNP Fall Conference, pp. 144, (2004).
[5] K. M. Koo, S. B. Kim, H.D. Kim, H. Y. Kang, and H. Y. Kang, "Design for a New Signals Analyzer through the Circuit Modeling Simulation under Severe Accident Conditions", Proceedings of IEEK Fall Conference, vol. 28, No. 2, pp. 171-174, (Nov. 2005).