

Integrated Validation System for a thermal-hydraulic system code, TASS/SMR-S

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Background



- Usually **thermal-hydraulic safety analysis computer codes** are consist of massive amount of source codes.
- The development including **enhancement and modification** of these codes is indispensable to a new reactor.
- In accordance with code modification, **the validation** is required.
- The physical effect of thermal-hydraulics in computer code can be validated by various **separate effect tests (SET)**. The compound effect could be compared with the results of an **integral effect test (IET)**.
- There are so many SETs and IETs for code validation. So the validation process of thermal-hydraulic computer code **requires lots of comparison** with the experimental data, especially for **nuclear reactor system**.

Introduction

- **IVS**
 - **The Integrated Validation System (IVS)** for the thermal-hydraulic system code, TASS/SMR-S
 - **TASS/SMR-S (Transient And Setpoint Simulation/System-integrated Modular Reactor-Safety)**
- **Necessity for Development**
 - The development including enhancement and modification of thermal-hydraulic system computer code is indispensable to a new reactor.
 - Whenever the code is modified, such as a physical model change or modification, the **code validation is required**.
 - **Lots of SET and IET test data** could be utilized for code validation.
- **Automate of Code Validation**
 - IVS can **automate** these time-consuming computer works efficiently.

IVS Software



– Software required:

- **Origin 8.1 or later**
- MS Word for graphs output
- MS Excel for data information file

– IVS program files:

- **ReadDraw.ogs: IVS script file**
- **GraphDoc.OP: Origin C object program file (portable format)**
- **LetterStyle.otp: graph template file**

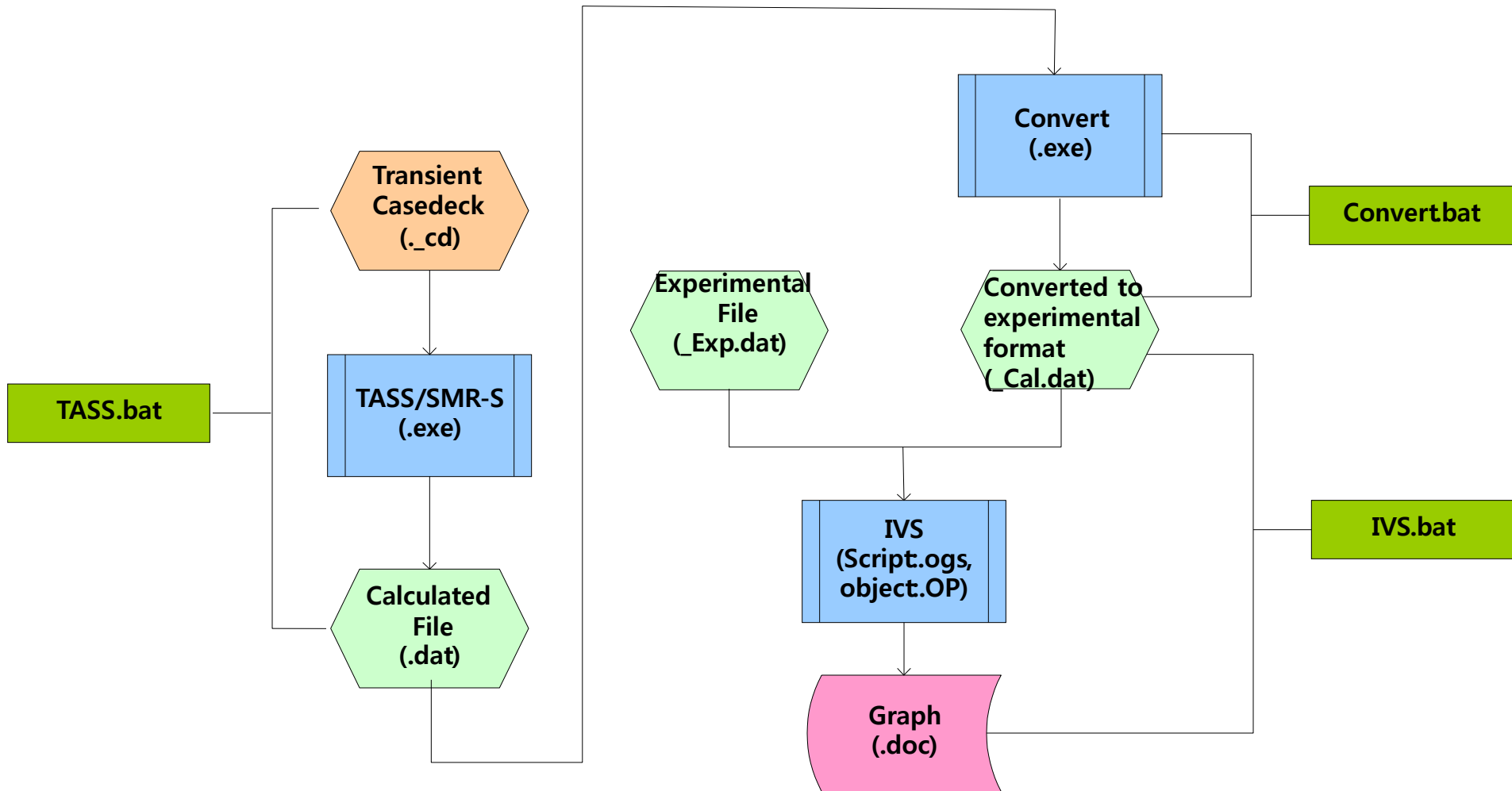
– IVS run files:

- **InputDesign.xlsx: input data information**
- **Input data file: test data with a spreadsheet style**
- **Run.bat: IVS batch file**

IVS Running Procedures

- **Prepare reference data**
 - Experimental results
 - XY spreadsheet style
- **Run TASS code**
 - Batch file run
 - Generating calculated results
- **Prepare comparable data**
 - Convert calculated results into experimental format
- **Run IVS**
 - Generate Origin graphs
 - Generate Word files
 - Check results using Word files

IVS Structure



IVS Run: Input Files

MS Excel

Directory Name	Case number	D:\Test\CodeTest\LabelTest\Data\Exp	D:\Test\CodeTest\LabelTest\Data\MSV11	D:\Test\CodeTest\LabelTest\Data\MSV11	D:\Test\CodeTest\LabelTest\Data\MSV11
Bennett	2	노심열전달BENNETT_1_Exp.dat	노심열전달BENNETT_1_Cal.dat	노심열전달BENNETT_1_Cal.dat	노심열전달BENNETT_1_Cal.dat
		노심열전달BENNETT_2_Exp.dat	노심열전달BENNETT_2_Cal.dat	노심열전달BENNETT_2_Cal.dat	노심열전달BENNETT_2_Cal.dat
GEswell	7	비동및Flashing_GE_Swell_Void(1)_Exp.dat	비동및Flashing_GE_Swell_Void(1)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(1)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(1)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(2)_Exp.dat	비동및Flashing_GE_Swell_Void(2)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(2)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(2)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(3)_Exp.dat	비동및Flashing_GE_Swell_Void(3)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(3)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(3)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(4)_Exp.dat	비동및Flashing_GE_Swell_Void(4)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(4)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(4)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(5)_Exp.dat	비동및Flashing_GE_Swell_Void(5)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(5)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(5)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(6)_Exp.dat	비동및Flashing_GE_Swell_Void(6)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(6)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(6)_Henry_Cal.dat
		비동및Flashing_GE_Swell_Void(7)_Exp.dat	비동및Flashing_GE_Swell_Void(7)_Henry_Cal.dat	비동및Flashing_GE_Swell_Void(7)_Moody_Cal.dat	비동및Flashing_GE_Swell_Void(7)_Henry_Cal.dat
end					

InputDesign.xlsx

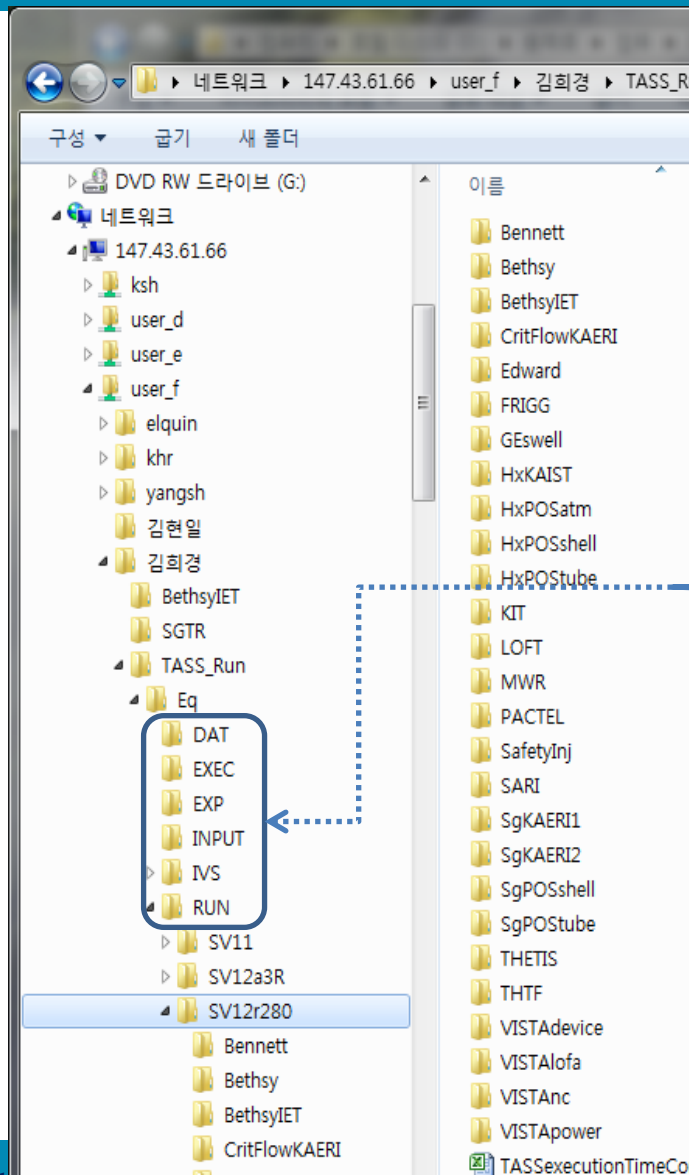
□ TASS code version

UltraEdit - [D:\Study\오리진\IVS\RunTest\RefRun\Conceptual\RefData\WNC_Case1_R166.dat]

TIME	PATH_FLOW (1)	NODE_PRESS (2)	NODE_TEMP (1)	NODE_TEMP (5)
sec	kg/sec	pa	degk	degk
0.000000	0.000000000E+00	0.200000000E+06	0.383380000E+03	0.383380000E+03
1.000000	0.116249947E-01	0.202919426E+06	0.384620469E+03	0.382141218E+03
2.000000	0.460863878E-01	0.209881838E+06	0.385810807E+03	0.380955626E+03
3.000000	0.101266548E+00	0.219510821E+06	0.386828833E+03	0.379943899E+03
4.000000	0.172352852E+00	0.228687881E+06	0.387524349E+03	0.379253532E+03
5.000000	0.251951990E+00	0.235101278E+06	0.387800700E+03	0.378978981E+03
6.000000	0.331179424E+00	0.238541507E+06	0.387668406E+03	0.379109759E+03
7.000000	0.401015210E+00	0.239693097E+06	0.387221067E+03	0.379554003E+03
8.000000	0.453716148E+00	0.238849232E+06	0.386575954E+03	0.380196060E+03
9.000000	0.484566771E+00	0.236113451E+06	0.385850805E+03	0.380918899E+03
10.000000	0.493304168E+00	0.231916886E+06	0.385164705E+03	0.381603509E+03
11.000000	0.483930480E+00	0.227004302E+06	0.384617855E+03	0.382149448E+03
12.000000	0.462852049E+00	0.222137392E+06	0.384262616E+03	0.382504030E+03
13.000000	0.436647083E+00	0.217879531E+06	0.384098720E+03	0.382667309E+03
14.000000	0.410615232E+00	0.214545486E+06	0.384091775E+03	0.382673646E+03
15.000000	0.388312752E+00	0.212245540E+06	0.384195182E+03	0.382569709E+03
16.000000	0.371697494E+00	0.210949559E+06	0.384363928E+03	0.382400586E+03

Input File: Spreadsheet style

IVS Run: Folder Structure

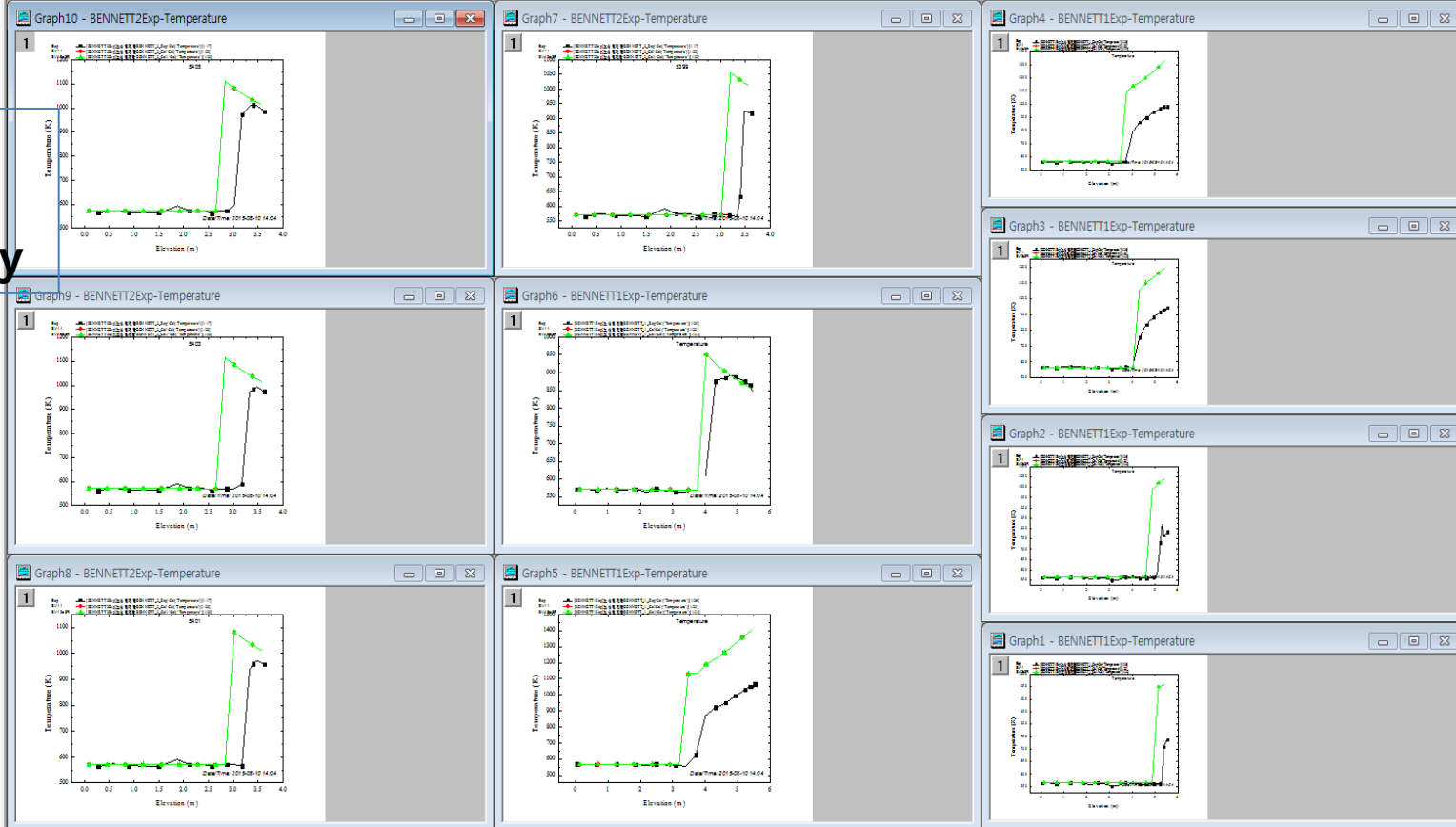


- **DAT: TASS calculated results**
- **EXEC: TASS execution file**
- **EXP: Experimental data**
- **INPUT: TASS casedecks**
- **IVS: IVS execution files**
- **RUN: IVS execution result files**

IVS Results: Compared graphs

Origin project

Graphs are generated automatically



Name	Size	Date	MC
Book1	8KB	2014-06	
InputDesign.xlsx	29...	2014-06	
노심열전달BENNETT_1_Exp.dat	34...	2014-06	
노심열전달BENNETT_2_Exp.dat	30...	2014-06	
BENNETT1Exp-Temperature	1 10...	2014-06	
BENNETT1Exp-Temperature	2 10...	2014-06	
BENNETT1Exp-Temperature	3 10...	2014-06	
BENNETT1Exp-Temperature	4 10...	2014-06	
BENNETT1Exp-Temperature	5 10...	2014-06	
BENNETT1Exp-Temperature	6 10...	2014-06	
BENNETT1Exp-Temperature	7 10...	2014-06	
BENNETT2Exp-Temperature	8 10...	2014-06	
BENNETT2Exp-Temperature	9 10...	2014-06	
BENNETT2Exp-Temperature	1 10...	2014-06	

IVS Results: Folder & Files

The screenshot shows a Windows Explorer window titled 'SV12a3R의 검색 결과'. The left sidebar displays a folder tree with the following structure:

- 김희경
 - BethsyIET
 - SGTR
 - TASS_Run
 - Eq
 - DAT
 - EXEC
 - EXP
 - INPUT
 - IUN
 - RUN
 - IVF29a2
 - Bennett
 - Bethsy
 - Edward
 - FRIGG
 - GEswell
 - HxKAIST
 - HxPOSatm
 - HxPOShell
 - HxPOSTube
 - KIT
 - PACTEL
 - SARI
 - THETIS
 - THTF
 - SV11
 - SV12a3R (selected)
 - SV12r280
 - SV12r280mod2
 - SV112

The main pane displays a table of search results:

이름	수정된 날짜	유형	크기	폴더
HxKAIST	2013-09-17 오후 5:42	Microsoft Word 9...	2,446KB	HxKAIST(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
HxPOSTube	2013-09-17 오후 5:41	Microsoft Word 9...	2,366KB	HxPOSTube(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
HxPOShell	2013-09-17 오후 5:40	Microsoft Word 9...	1,390KB	HxPOShell(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
HxPOSatm	2013-09-17 오후 5:39	Microsoft Word 9...	5,801KB	HxPOSatm(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
THETIS	2013-09-17 오후 5:37	Microsoft Word 9...	417KB	THETIS(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
KIT	2013-09-17 오후 5:37	Microsoft Word 9...	821KB	KIT(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
GEswell	2013-09-17 오후 5:36	Microsoft Word 9...	1,301KB	GEswell(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
Frigg	2013-09-17 오후 5:36	Microsoft Word 9...	415KB	FRIGG(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
Edward	2013-09-17 오후 5:35	Microsoft Word 9...	293KB	Edward(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
THTF	2013-09-17 오후 5:35	Microsoft Word 9...	1,416KB	THTF(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
Bennett	2013-09-17 오후 5:34	Microsoft Word 9...	1,310KB	Bennett(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
PACTEL	2013-09-17 오후 5:34	Microsoft Word 9...	301KB	PACTEL(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)
SARI	2013-09-17 오후 5:33	Microsoft Word 9...	294KB	SARI(\\147.43.61.66#user_f#김희경#TASS_Run#Eq#RUN#SV12a3R)

Annotations in the image include:

- Compared results are saved**: Points to the search results table.
- Experiments are grouped by folders**: Points to the folder tree structure.
- Different code versions are arranged by folders**: Points to the folder tree structure, specifically highlighting the 'SV12a3R' folder.

IVS Results: File contents

MS Word

Generated graphs by Origin are saved on MS Word automatically

이 문서에 제목이 없습니다.

탐색 탭을 만들려면 [제목 스타일]을 적용하여 문서에 제목을 만드십시오.

Conclusions

- **IVS** was developed for an **automated validation of TASS/SMR-S code.**
- **The code validation could be achieved by a comparison code calculation results with corresponding test results.**
- **IVS could be applicable to other software's validation with minor modifications.**