



OPTIMAL DESIGN OF VACUUM CIRCUIT BREAKERS

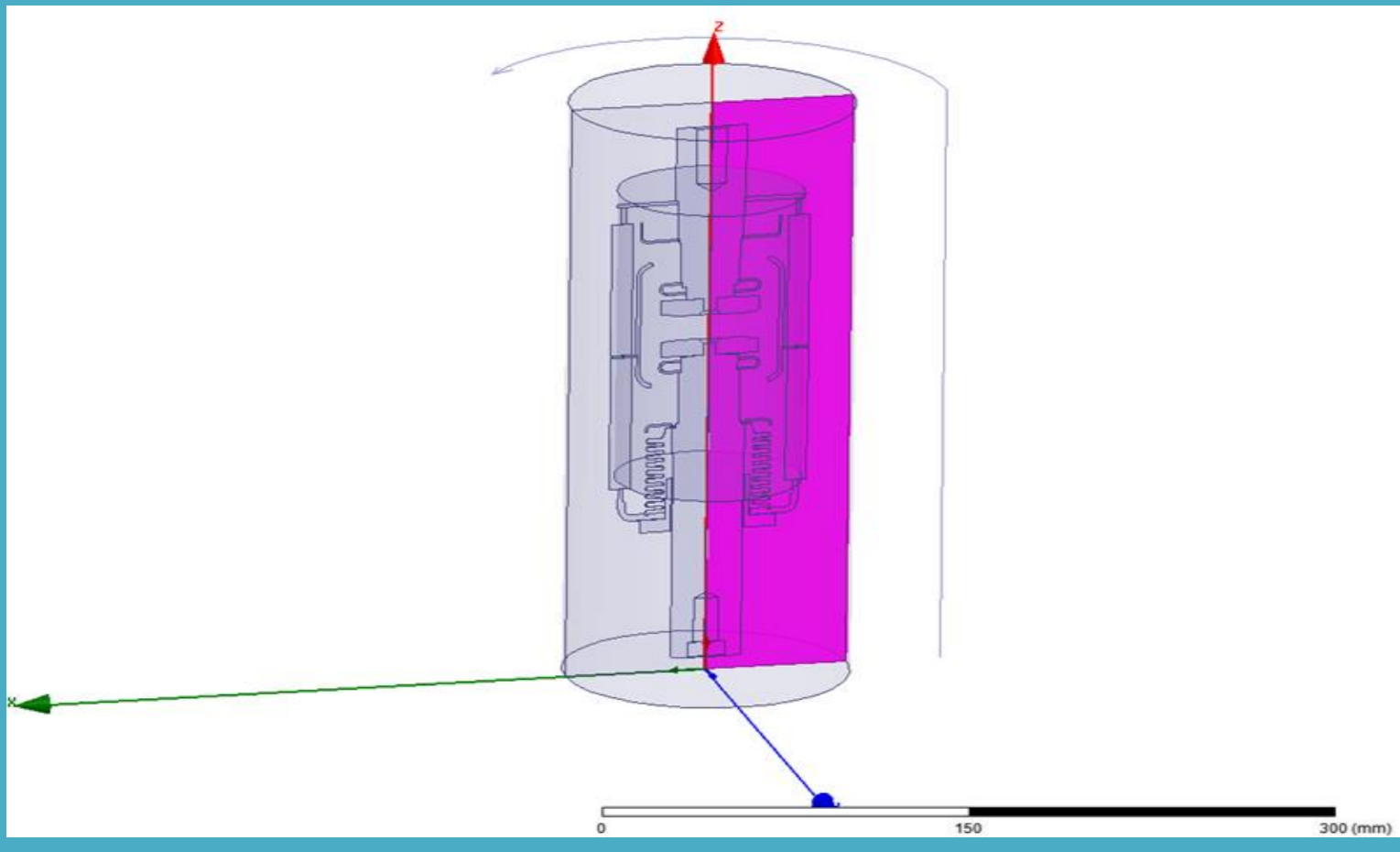
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INTRODUCTION

Nowadays, digital analyze methods is being used to decrease research and devolpment costs and also used for increasing product quality. In this project, vacuum circuit breaker design analyzed and optimized with designed user interface. Main aim of this project is getting perfect electric field distribution with optimization. And get new design optimized design of the vacuum circuit breaker.

AXIAL SYMMETRY

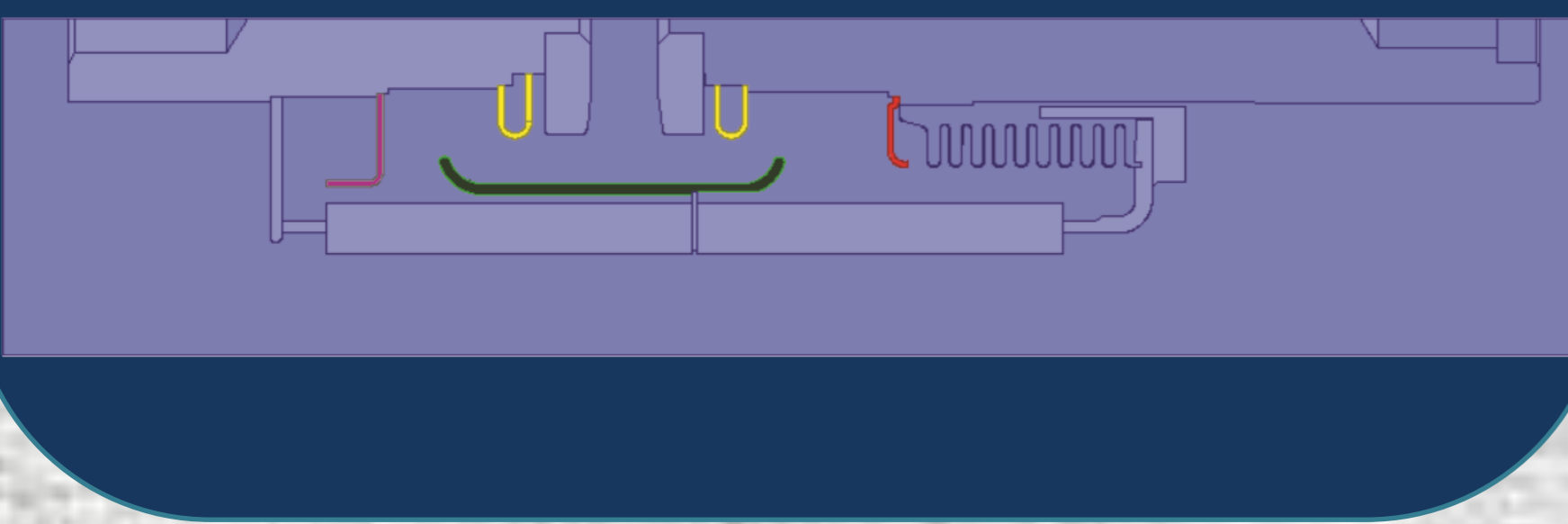


Axial Symmetric Design of Vacuum Interrupter

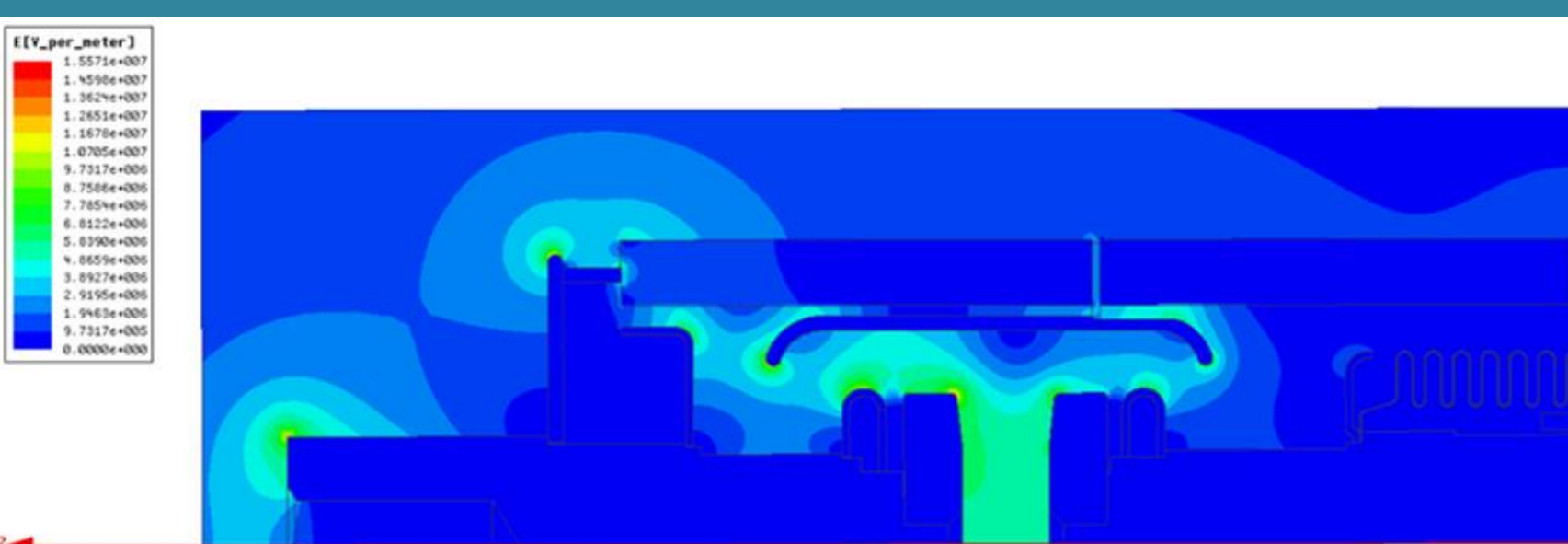
DESIGN PARAMETERS

	Shield1	Shield2	Shield3	Shield4
Initial Value	Shield1 - % 5	- % 10	- % 10	
1st Iteration	+ % 2.5	- % 2.5	- % 5	- % 5
2nd Iteration	+ % 5	Shield2	Shield3	Shield4
3rd Iteration	+ % 7.5	+ % 2.5	+ % 5	+ % 5
4th Iteration	+ % 10	+ % 5	+ % 10	+ % 10

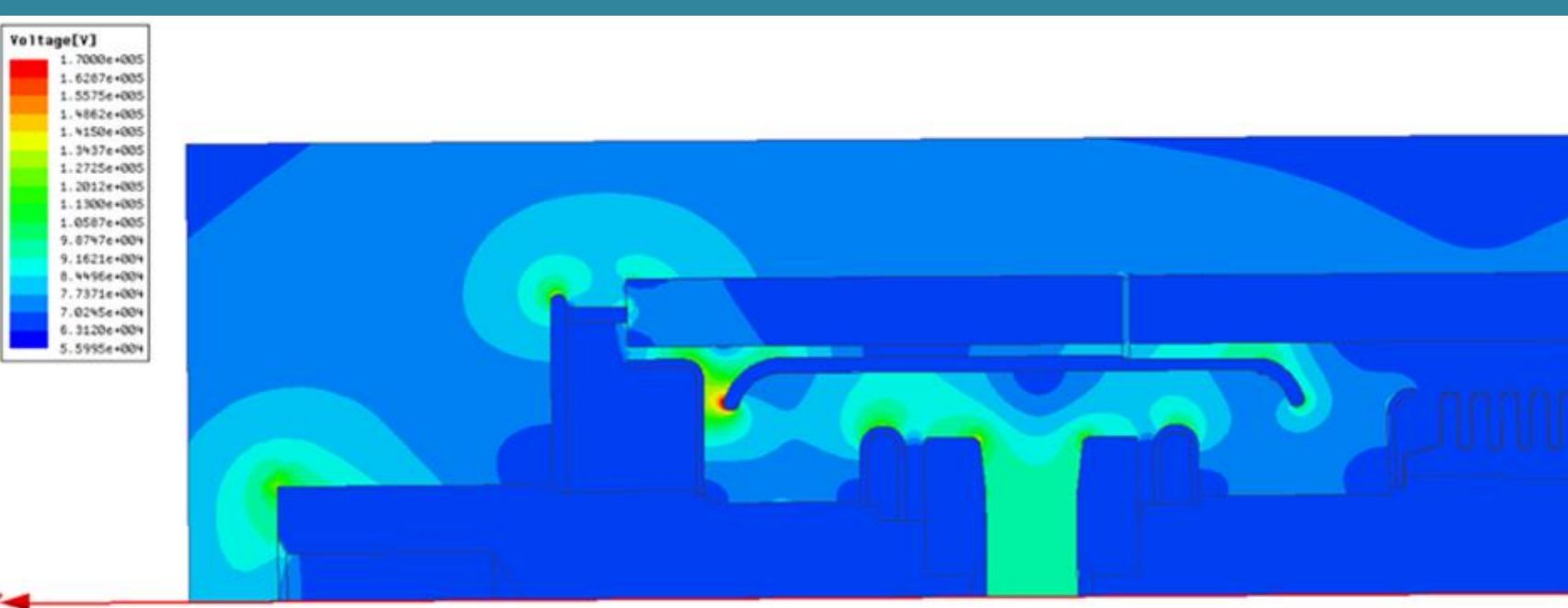
■ shield1
■ shield2
■ shield3
■ shield4



RESULTS



Vacuum Interrupter Original Design Electric Field Analysis



Vacuum Interrupter Optimized Design Electric Field Analysis

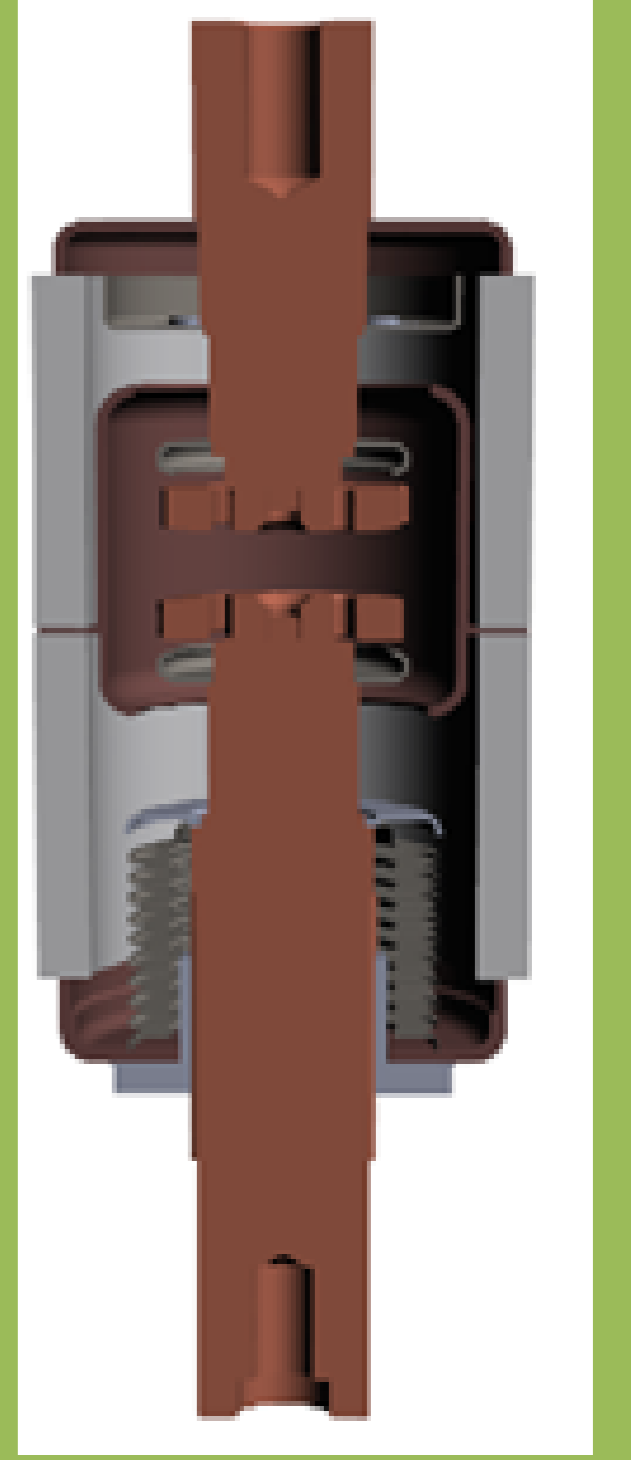
VACUUM CIRCUIT BREAKERS

A circuit breaker is an electrical switch which is operated automatically to protect an electrical circuit from damage caused by overload or short-circuit.

There are different techniques to interrupt the arc:

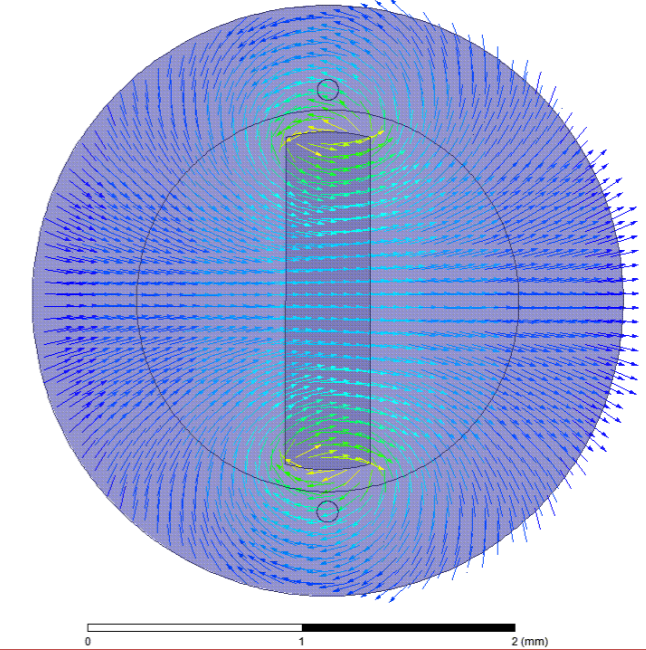
- Vacuum
- Air
- Insulating gas
- Oil

Vacuum technology has proven itself by replacing other arc-quenching media such as SF6 or oil, for many switching applications especially in the medium voltage sector.



ANSYS MAXWELL & VBSCRIPT INTEGRATION

ANSYS-Maxwell software calculates the electrostatic analyze by dividing the selected design in maximum count of pieces and applying Maxwell Equations on every piece of each object, therefore it uses a collaboration of Maxwell equations and FEM.



Maxwell software has some predefined functions for Interfacing VBScripts. In this project, maxwell software interfaced with VBScript.

MESH AND ELECTRIC FIELD DATAS PROCESSING

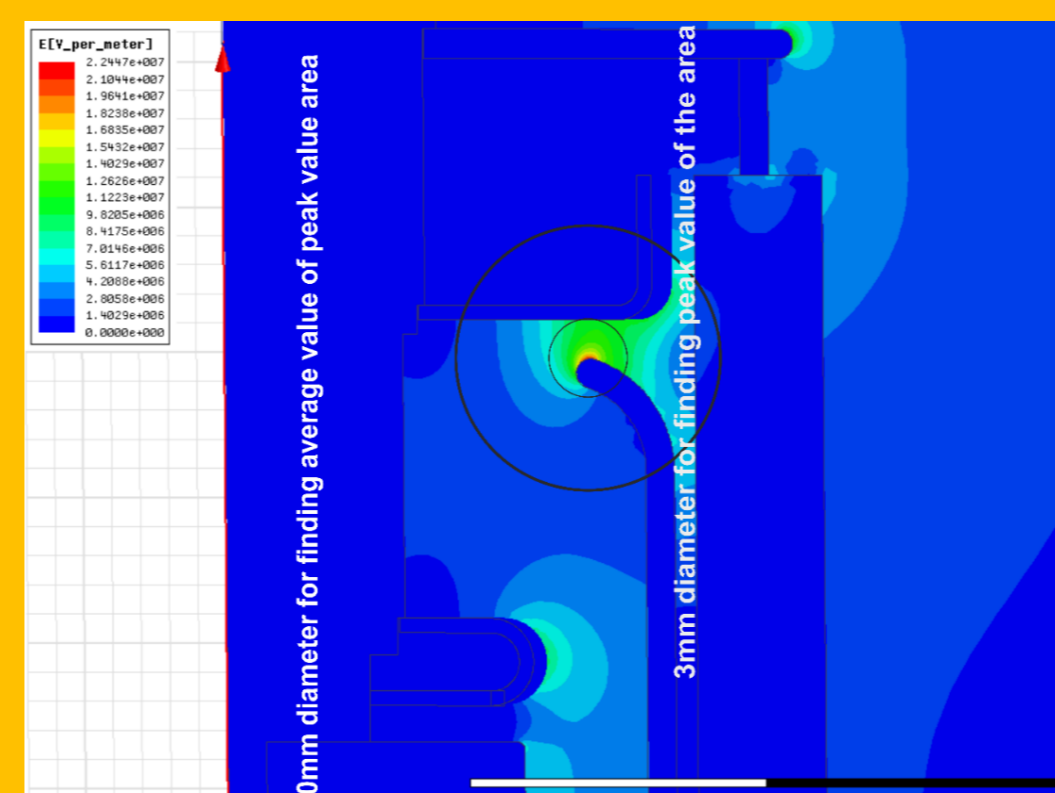
Maxwell software does not give output electric field values of the every nodes. ASEPH software get these datas from internal files of Maxwell.

Nodes	Element Solutions
10	60,0,5.9917 76688
11	60,0,5549 503
12	60,0,7155 526
13	60,0,8082 554
14	60,0,464756 584497
15	60,0,77.7626
16	60,0,88.0782 796603
17	60,0,98.368 801618
18	60,0,108.722 799917
19	60,0,119.058 820206
20	60,0,129.613 868711
21	60,0,140.119 930909
22	60,0,149.813 987766

1	0	302	40	125	11642	1713				
2	1									
3	4	0								
4	73665	36706								
5	2	3	0	6	2901	33411	5268	33410	33428	2904
6	2	3	0	6	6033	49708	6032	33417	33416	2902
7	2	3	0	6	2904	33429	6326	33410	33412	2901
8	2	3	0	6	10084	33434	2905	45454	33433	5267
9	2	3	0	6	10639	33431	2904	45458	33428	5268
10	2	3	0	6	10640	45455	5267	33436	33433	2905
11	2	3	0	6	10640	33436	2905	66825	33435	10639
12	2	3	0	6	10639	45458	5268	66825	45459	10640
13	2	3	0	6	6032	49712	10874	33422	33424	2903
14	2	3	0	6	10874	33415	2901	50683	33412	6326
15	2	3	0	6	6326	33423	2903	50683	33424	10874
16	2	3	0	6	2902	33420	10905	33417	49715	6033

Elements, nodes and element solutions processed and save files for each analyze.

INFORMATION LIMITING PROCESS & OPTIMIZATION



Dielectric constant of high field vacuum is approximately between 20000V/mm-40000V/mm. In this software this maximum value has taken 14000V/mm. Every point over this value is a risky point for this software.