ISSN 2278-7763

Thus, electric arc physical models consider the conservation laws for mass; momentum and energy for arc macroscopic elements, but extra source terms are added. On one hand Lorentz-force density term $(\vec{j} \times \vec{B})$ added in the momentum balance and on the other hand the ohmic heating term $(\vec{j} \cdot \vec{E})$ in the energy balance. Those extra terms couple flow dynamics with electromagnetic process, described by Maxwell's equation [(4)-(7)].

For solving combine MHD Equations magnetic model of an arc is described in detail which shows the behavior of an Arc.

3 ELECTROMAGNETIC MODEL

3.1 Model geometry

The geometry used here is enclosure without opening with copper copper contact in the air as fluid inside the enclosure. The contacts are fixed and the whole geometry is in positive xyz region. As shown in the figure 1.3 the fixed length has been taken for the measure of behavior of the arc.

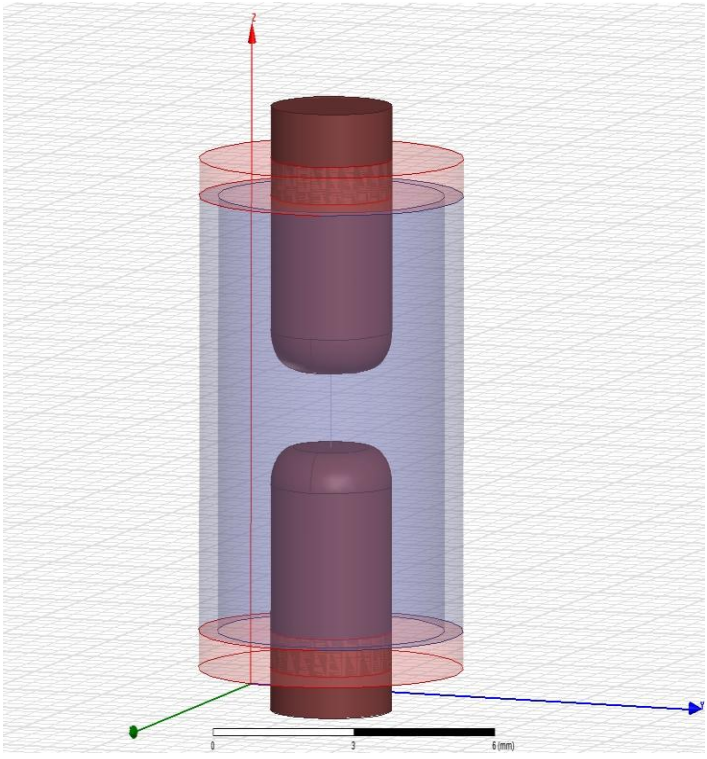


Figure 3.1 Geometry for Arc Model.

The wall of the enclosure taken here is insulating type. The distance between two contacts is very small. The model has taken z – axis as reference for gravity.

3.2 The simulations inputs and test data

The geometry shown in figure has been applied voltage and current source. One contact has been applied fixed current at the fixed direction and voltage to other contact with fixed direction. The simulation time for the analysis 5ms and whole result are analyses for 0 to 1ns.

4 SIMULATION RESULTS

The simulation is carried out with Ansoft Maxwell 15.0 and Ansys 14.5 software tools.

4.1 Time varying j, E and w

Above figure show the t=0 time there is no magnetic field applied .after that the t=0.4ns the magnetic field has been start developing in the air in the enclosure the direction of the vector j is also shown in the figure 3.2.The intensity of the field is strong near the contact as arc starts developing in this stage.

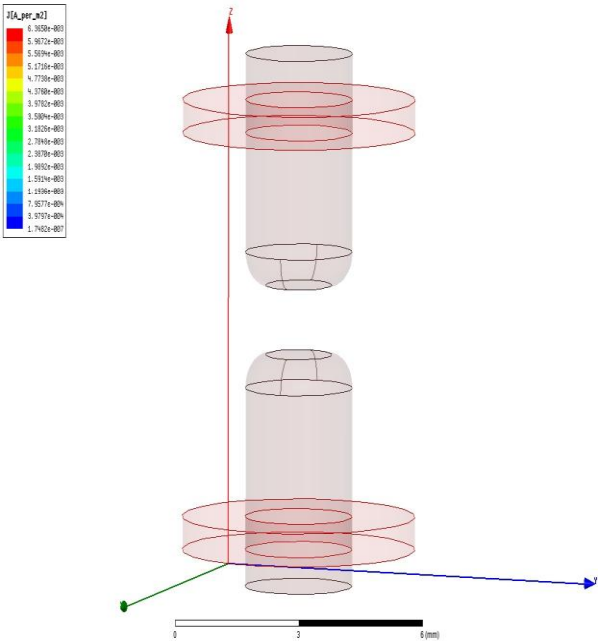


Figure 3.1 Current density j at t=0 sec.

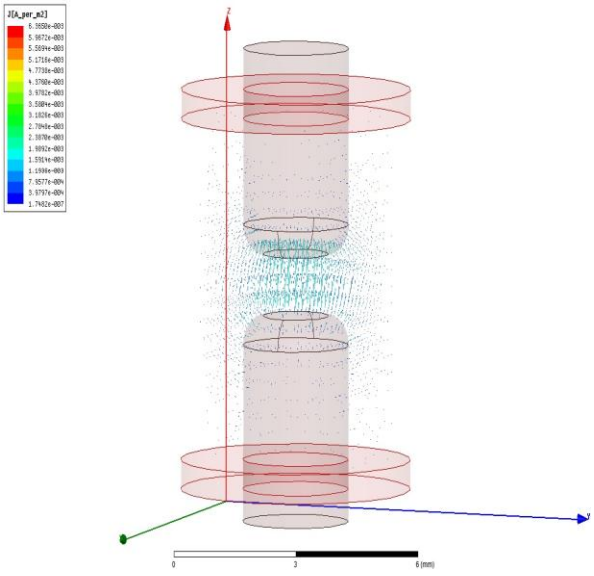


Figure 3.2 Current density j at 0.4ns

ISSN 2278-7763

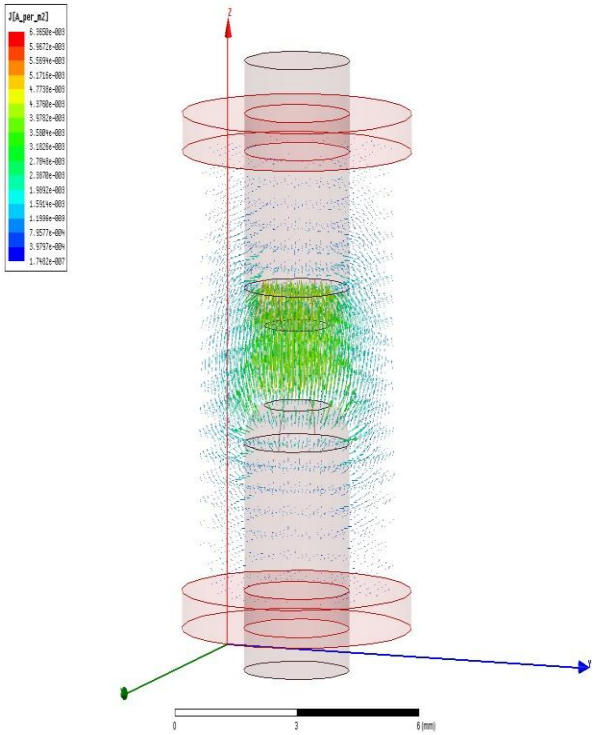
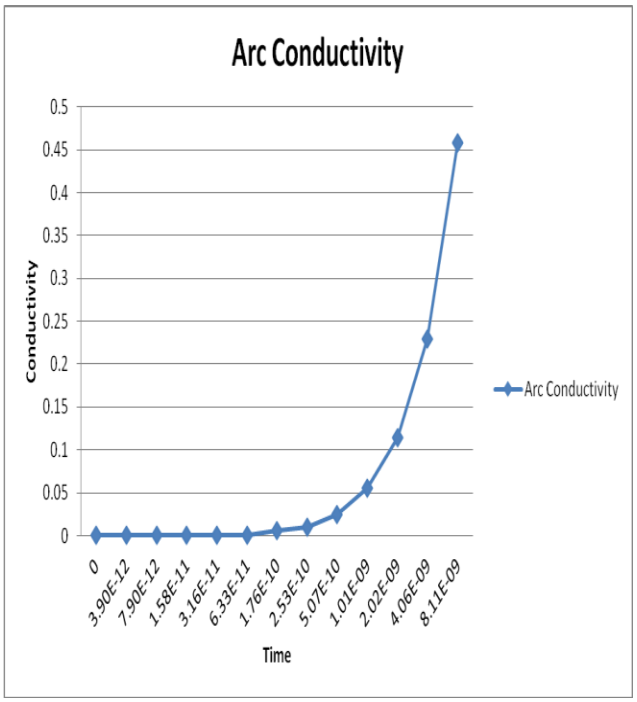


Figure 3.3 Current Density j at 1ns.



Graph 4.1 conductivity of Arc vs. time

2) Transient behavior:

The electric field and magnetic field values from the t=0 to t=1ns has been observed by model .The heat losses is rapidly increases during the t = 0+.As current zero achieved the direction of the j and E reversed as sinusoidal voltage and current has been applied and so at current zero heat looses is low and that is the time to open the contact so as much as safe operation has been followed and finally arc will extinguished.

4 ANALYSES OF THE SIMULATION

To find the characteristically behavior of the intercontact gap.

Using E and j values,

$$j = \sigma E \quad \ldots\ldots\ldots (8)$$

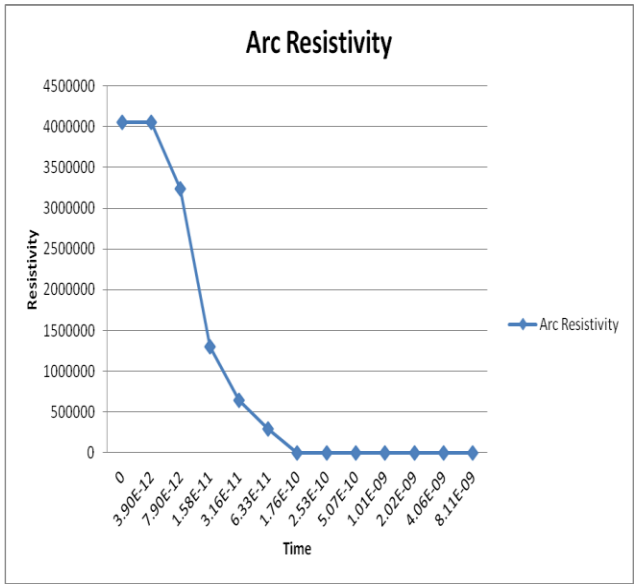
$$\sigma = j/E \quad \ldots\ldots\ldots (9)$$

$$R = 1/\sigma \quad \ldots\ldots\ldots (10)$$

Where,
j=Current density in the air, (A/m^2);
E=Electric field intensity in air, (V/m)
R=resistance of an arc, (Ω)
σ = Conductivity of an Arc, (℧)

Using above Equation (8) and (9),

The behavior of the arc is shown in graphs,



Graph 4.2 Resistivity of Arc vs. Time

5 CONCLUSION

The arc resistivity clearly shows that in the beginning at t=0 arc resistance in $10^6\Omega$ than rapidly decreased in the few ns. It is zero at 1.76×10^{-10} sec. Arc is taken place with thermal break down of the air. The current density rapidly starts increases as shown in the model, as this model shows the dynamic behavior of an arc.

5 ACKNOWLEDGMENTS

We would like to thanks Dr.M.K.Shah for his Support throughout the work. We would also like to thanks Dr.V.Shrinet for giving me lots of space to work in the technical environments.

6 REFERENCES

[1] Wu Xi-xiu[1], Li Zhen-Biao[2], Tian Yun[2], Mao Wenjun[3], Xie Xun, " Investigate on the Simulation of black box arc model," 2011 1st International Conference on Electric Power Equipment - Switching Technology - Xi'an - China, pp. 629-639,2011.

[2] A. Iturregi[1], E. Torres[2], I. Zamora[3] , "Analysis of the Electric Arc in Low Voltage Circuit Breakers," International Conference on Renewable Energies and Power Quality, Las Palmas de Gran Canaria (Spain), 13th to 15th April, 2011

[3] William Bussire Pascal An Dr.David Rochette, Stphane Clain and Charles Besnard," Porous _lter optimization to improve the safetyof the medium-voltage electrical installations during an internal arc fault," IEEE transactions on power delivery, 25, no. 4, october2010.

7. BIOGRAPHIES

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