Plasma Holes

Ok as things start to wonder a bit, maybe it's easier to have an email chain about the topics? So the next stuff is just about holes and how you cut them. Please bear in mind that what I say is used in high def thicknessed 3-50mm and above. I don't think it makes much sense (future in mind) to do something half assed that works only on A120, PMX, Cutfire and so on. If you want to make it proper, then try to make it flexible.

Please note that the stuff below is just how to generate the cut path, doing actual cut tests is then another thing :)

First of all forget the kerf crossing for now, and note that the kind of special holes I am talking about are always cut with AVC OFF. You want to minimize the factors that affect the hole quality and changing height is one thing. So for now orient yourself to cut the holes without AVC. After this is "in the bag" you can try with AVC ON.

Where to start??? I want to apologize in advance, I'll try to keep this simple as readable but I'm a bit afraid I can't.

Maybe about the data?
Data
The data structure can be anything but most of the time OEMs will get an excel sheet, csv or both. In the examples below I will use csv as an example but it can be "anything". The numbers also are just random and probably do not work in the real world.

So you have a csv that contains data for 50 different processes, each process then containing 3 hole sizes. You need an identifier for the specific process that you can match with the data from CAM and what you want to cut. So if you want to cut 4mm mild steel 65A or 15mm mild steel 120A, you will need to match the data with CAM and LCNC. Below is a crude example:

// ID Hole_size Leadin_r Kerf Cut_height Speed1 Speed2 Speed2_distance Plasma_OFF Over_Cut
0024,6,4,2.2,1.25,1300,900,4,8,3
0024,12,8,2.1,1.25,1600,900,4,6,2
0024,30,21,1.9,1.5,2000,900,4,4,2

ID You identifier [0024]
Hole_size Size of the hole to be cut [6,12,30]
Leadin_r Leadin radius [4,8,21]
Kerf Hole specific kerf [2.2, 2.1, 1.9]
Cut_height Hole specific cutting height [1.25, 1.25, 1.5]
**Speed1** Speed until Speed2 or end of hole [1300,1600,2000]
Speed2 Speed from a specific distance until the end of the hole [900,900,900]
Speed2_distance Distance from the end towards beginning to apply speed2 [4, 4, 4]
Plasma_OFF Distance from the end where plasma is commanded off. Typically the plasma is commanded of around the point where the slug drops. X/Y motion continues even when arc is ramped down or OFF. [8, 6, 4]
Over_Cut Extended cut path [4,4,2]

All the distances are calculated from the end point, meaning when overcut has been applied. So if we say the hole is a clock face, we forget the leadin and start/end point is at 12 o'clock.
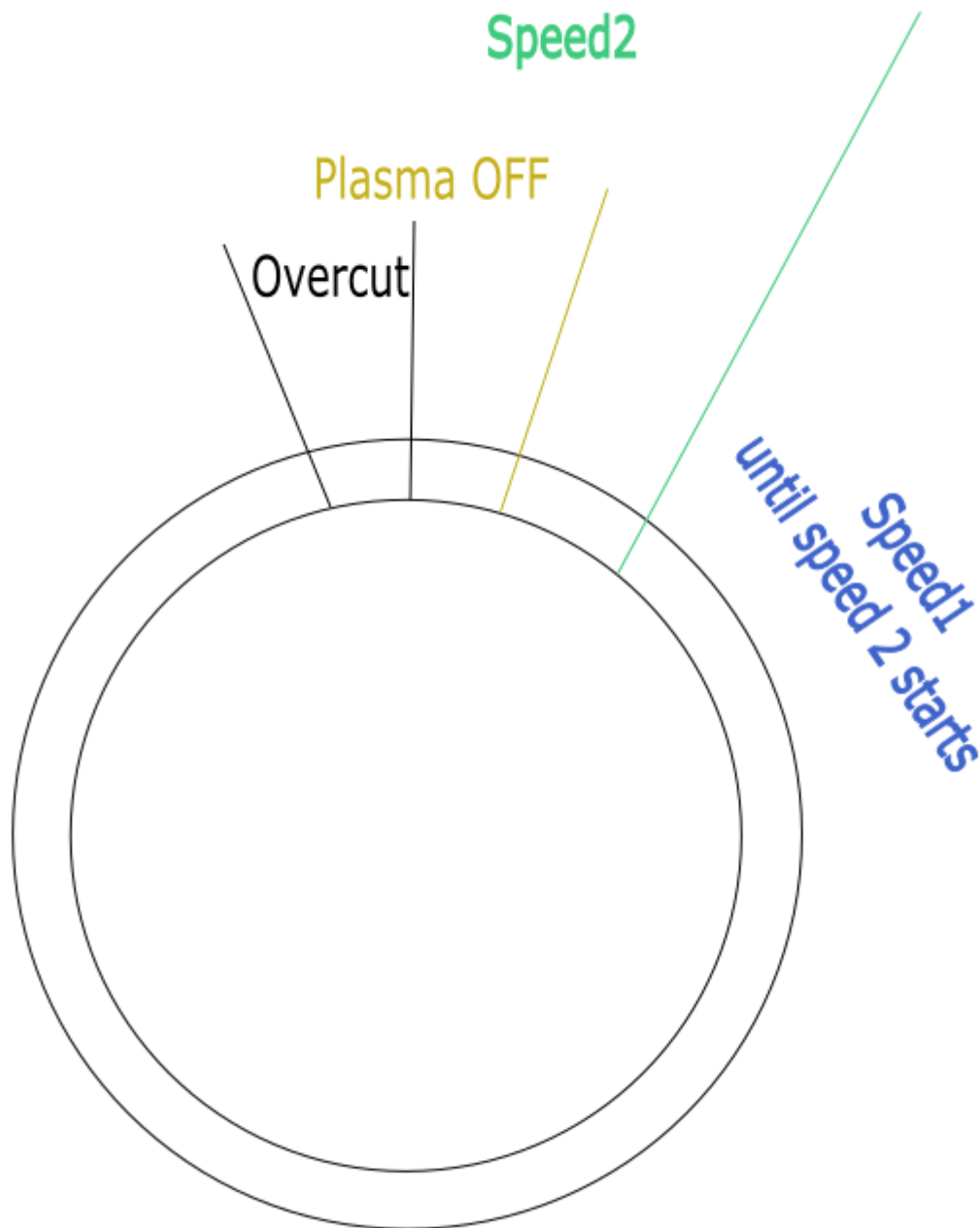

So all distances are counted from the end of overcut.

You would add these params to Philips code, so you open a file read in the gcode and then add the stuff from your database. Now it looks like it mostly opens, adds/changes fixed parameters and saves/open to screen.
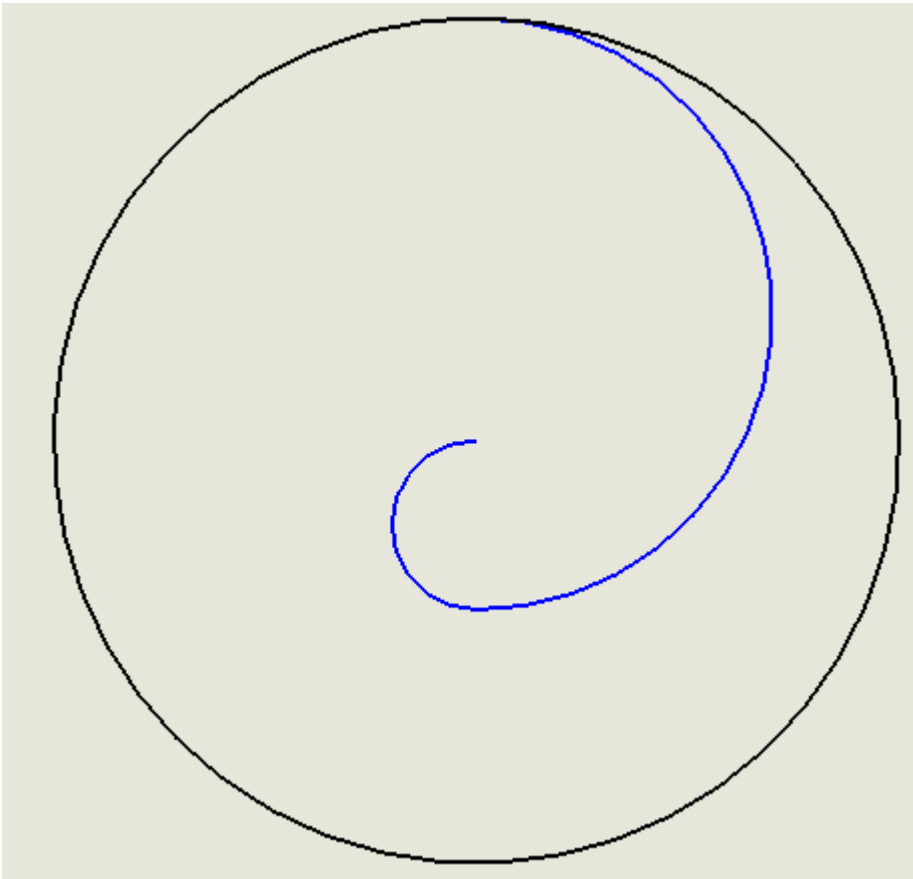
Leadin
Leadin, so like I said the typical ones are J and half circle. But not the half circle you had in mind. So you had a center start half circle and that's pretty much static, it's always with a fixed r in reference to the hole size. "Nobody" does this, again coming from the high end machines. Quickly looking at an example hypertherm and it looks like a half circle but it's not (at least every time). The idea is to have a half circle with a radius that can change and still start in center, this then requires
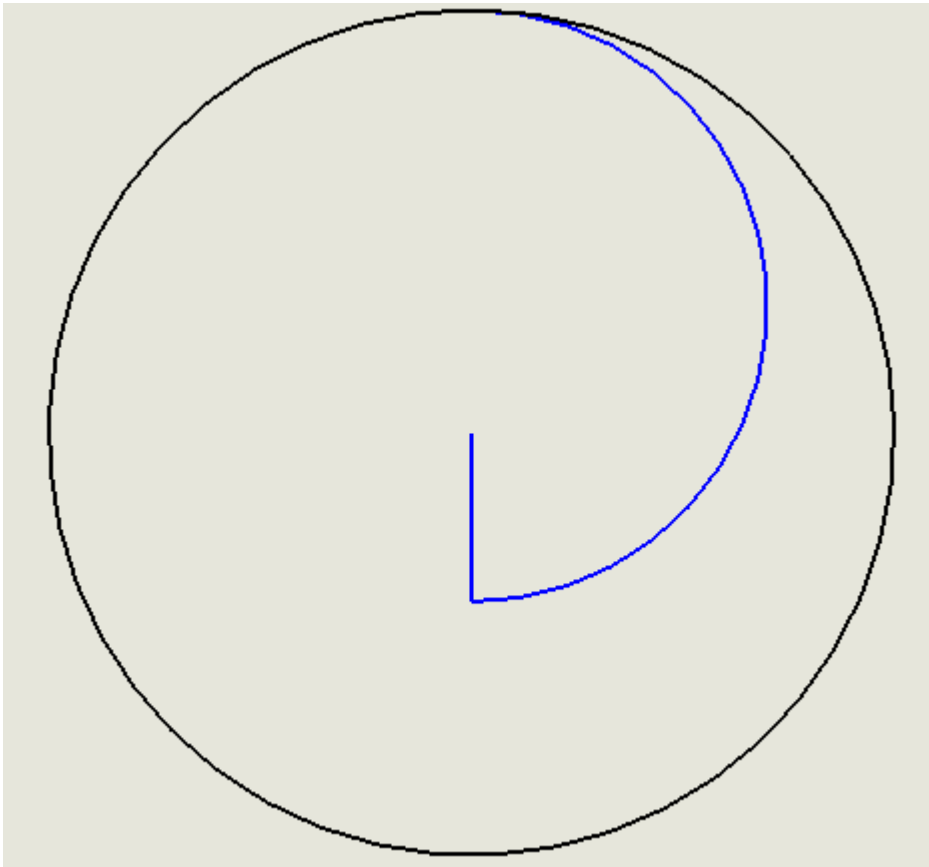
either a 3rd arc or a straight (the half circle consists of 2 arcs). So you have a half circle tangential to the hole:
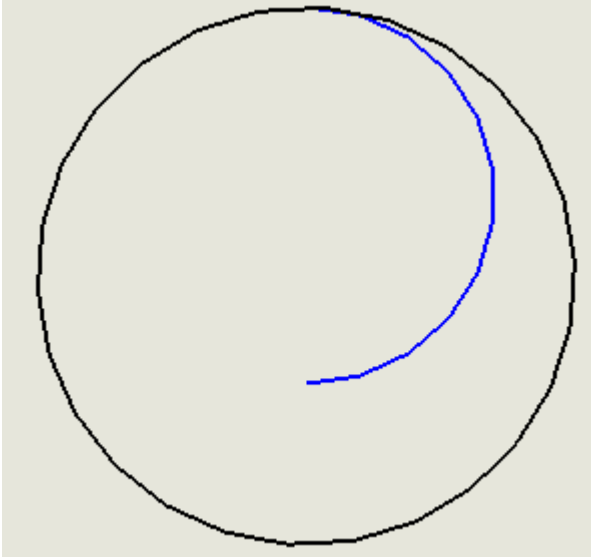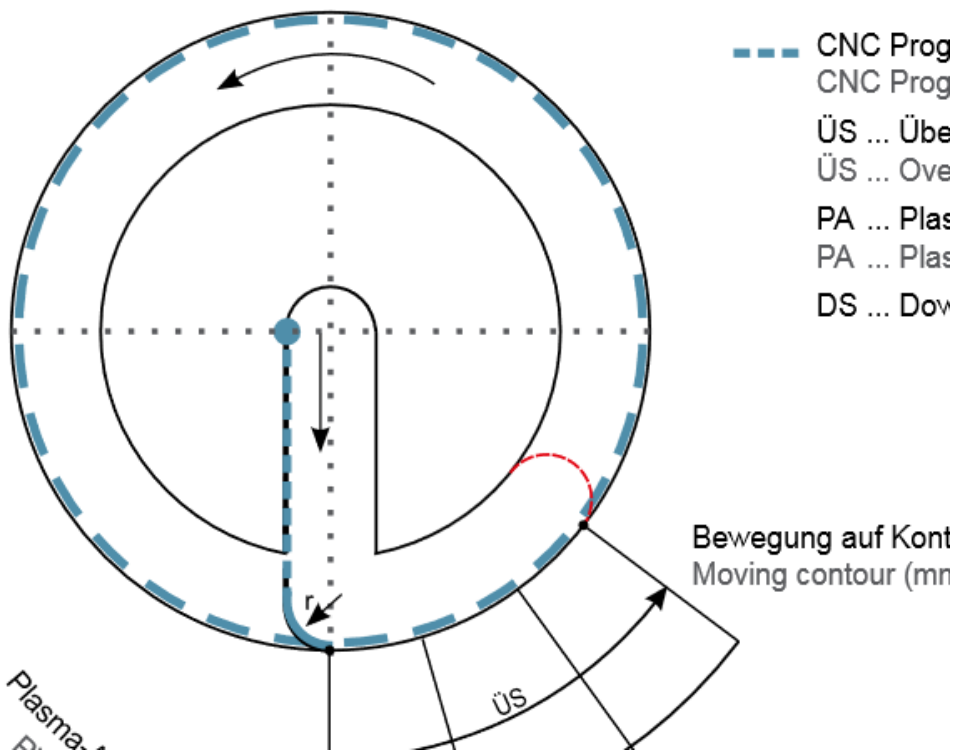

As you see this does not start from the center but you might require to have a radius like this for some material/thickness/hole size combo.

So you add a 3rd arc or a straight line from the center that connects to this:

Hyperherm ramps the kerf to get sort of like a spiral in some cases, TD does it with a line/arc/J and Kjellberg uses a J:

CNC Prog
CNC Prog

ÜS ... Übe
ÜS ... Ove

PA ... Plas
PA ... Plas

DS ... Dov

Bewegung auf Kont
Moving contour (mn

Plasma

ÜS

So now we have our leadin.

Then the rest is interpolating so if you have example 3 data points (I would say that the minimum) 1:1, 2:1, 5:1 hole to plate thickness ratio. 10mm plate and you have 10mm, 20mm and 50mm hole data. You use
1:1 data for holes <10mm
2:1 to holes >10-20mm
5:1 to holes <20-50mm

Then lets say cut speed for 1:1mm is 1000mm/min and 2:1 is 2000mm, you would interpolate the between so cut a 12mm hole with a speed of 1200mm, this you then do to all params.

When you don't have data from the mfgt it's a lot of work, sweat and plate to come up with working hole data. So ideally you would have a tool to generate just holes where you can "manipulate" the data and then save the end result. So cut a hole, tweak a param, cut again then rinse and repeat 10-100 times for a specific process and multiplied by 3 as you need different sizes.

By implementing the above, with a high def machine you are able to cut holes that you can tap. on air/air not sure, I don't think anybody has done anything like this for the "low end" machines. And this is quite easy to extend to slots etc (not many do this).

Hope this makes sense and helps,