Hi Mark,

Providing highly spin polarized electron beams to Hal D is entirely reasonable and tractable, just like with the other halls.   I start with the “standard” info and conclude with the biggest issue to address, bleed through.

Delivering polarized beam at 12 GeV, in general.

There do not appear to be any show stoppers, but here are the respective comments:

1. We have an Elegant based code that includes SR and calculates the spin precession to Halls A, B, C as reliably as we know the beam energy.   We would add the capability for Hall D to the on-line calculator, a modest task.
2. However, experimental alignment or acceptance of the beam polarization is the responsibility of the halls (it’s actually a line item the standing experimental memo each time issued).   Fortunately, a spin dance does not require very high point-wise precision; utilizing some reliable physics reaction could suffice. For example, a 3-point spin dance with ~few percent precision, could be replaced by a 5-point spin dance with ~10 percent precision.   Additionally, a Hall D energy measurement and/or spin dance or energy measurement by another hall at a lower pass (e.g. 11 GeV) validate the beam energy being used in the spin calculator.
3. Scheduling is the most difficult, but this is administrative.   We have two entirely independent degrees of freedom (injector Wien filters, average linac energy), and constrained degrees of free (variation of injector and linac energies); all cases can be explored in advance by simulation.
4. Depolarization due to SR is calculated to be less than one percent; experimentally we have not been able to observe depolarization between the injector and Halls A or C at 11 GeV.
5. The injector Mott polarimeter (or another hall polarimeter) can measure the polarization for Hall D.   We are soon to publish a manuscript in PRC that reports on the Mott and concludes we believe to measurement the polarization to better than 1% now.

Pull Helicity signal fibers from MCC to Hall D

A trunk of 4 + spare fibers needs to be pulled from the MCC to Hall D to transmit the usual delayed helicity timing and status information.   There already exist the a fan-out of these fibers ready for Hall D at the MCC.

Upgrade the 4-laser IA (intensity asymmetry) Pockels cell system to include Hall D

When the Hall D laser was added there was no need to upgrade the 3-hall IA system.   Adding the additional IA (Pockels cell + remotely controlled waveplate) to the laser is straight-forward. However, we’ll need to upgrade the controller for 4-laser and fabricate new electronics and purchase PS for the system. Mainly, the project would need to get on the schedule to design, prototype, and test before being installed, so imagine 6-12 months lead time.

Bleed through depolarizes your beam, is it acceptable?

The electron polarization will be the weighted average of all beams that reach Hall D, call it $\langle P_D \rangle$, so in general is like this:

$$\langle P_D \rangle = [(I_A*P_A) + (I_B*P_B) + (I_C*P_C) + (I_D*P_D)] / (I_A + I_B + I_C + I_D)$$

This can be simplified:

- polarization produced by each laser is essentially the same, call it *P0*.
- Two lasers have one helicity and vice versa e.g. Halls A/B have *-P0*, Halls C/D have *+P0*.

Combining these factors and remembering that $I_{tot} = I_A + I_B + I_C + I_D$,

$$Depol = \langle P_D \rangle / P0 = [I_{tot} - 2*(I_A + I_B)] / I_{tot} \quad \text{(depends on Halls A \& B bleed)}$$

- If assume bleed through per laser same, then $I_{bleed} = I_A = I_B$.

$$Depol = \langle P_D \rangle / P0 = [I_{tot} - 4*I_{bleed}] / I_{tot}$$

Here's a small table of Depol (i.e. 0.840 means P=0.840*P0) vs. (I_total,I_bleed):

	Total Hall D Current (nA)			
Bleed/laser (nA)	50	100	150	200
2	0.840	0.920	0.947	0.960
4	0.680	0.840	0.893	0.920
6	0.520	0.760	0.840	0.880

There are ways to mitigate the bleed through depolarization:

1. Run the Hall D program when Hall B runs an unpolarized experiment, so that Hall D may use the narrow slit; this would entail some beam studies to make sure Hall B is compatible with the "wide longitudinal acceptance" that they normally do not need to deal with.
2. Ideally, schedule Hall D experiment during a period of 3-hall operations, so you have your "own" slit to reduce bleed through somewhat arbitrarily,
3. Tell the PAC that CEBAF should have a 4-beam chopper, so you can have your "own" slit all the time. There is a scheme and perhaps your proposal can help us elevate it's priority.

4. Less than optimal, share the Hall B slit. This requires operating at very nearly the same average current through the experiment, and is complicated when the B slit is "opened" for respective tuning; but otherwise is possible.
5. Our group is working on developing and testing a laser that eliminates bleed through, but this is an R&D project now. It's important for CEBAF future, but too early to forecast.

$$\langle P_D \rangle = \frac{(I_A P_A + I_B P_B + I_C P_C + I_D P_D)}{(I_A + I_B + I_C + I_D)}$$

w/

$$P_A = P_B = -P_0$$
$$P_C = P_D = +P_0$$
$$I_{TOT} = I_A + I_B + I_C + I_D$$

$$\langle P_D \rangle = \frac{P_0(-I_A - I_B + I_C + I_D)}{I_{TOT}}$$

$$= P_0(-I_A - I_B + \cancel{I_C} + I_{TOT} - I_A - I_B - \cancel{I_C}) / I_{TOT}$$

$$\boxed{\langle P_D \rangle = P_0(I_{TOT} - 2I_A - 2I_B) / I_{TOT}}$$